THE SEWERAGE OF NAHANT.

[From 4th Annual Report of the Mass., State Board of Health, Lunacy and Charity.]

BY E. W. BOWDITCH, SANITARY ENGINEER.

The little town of Nahant, one hundredth part of the area of Plymouth, was considerably disturbed during the latter half of 1881, and the first half of 1882, by the appearance of typhoid fever in various parts of the town.

The questions then presented for solution were,—

1st. What was the cause of the disease?
2d. What should be the remedy?
3d. How long would it take to give relief?
4th. What would it cost?

The disease being zymotic, the remedies suggested were largely those that would be prescribed by a Board of Health—cleaning of premises, securing better drainage, plumbing, etc., and removal of all decomposing matter; afterwards trying to better the quality of water, ice, milk, etc.

Without going into details that would prove but repetitions of what may be already fairly well known, the writer desires to call attention in as few words as possible to those portions of the work that may not be so well understood; viz., separate sewerage, and the apparent recovery of the soil after pollution.

The former of these two subjects is better understood, perhaps, than the latter, although still imperfectly known in this country.

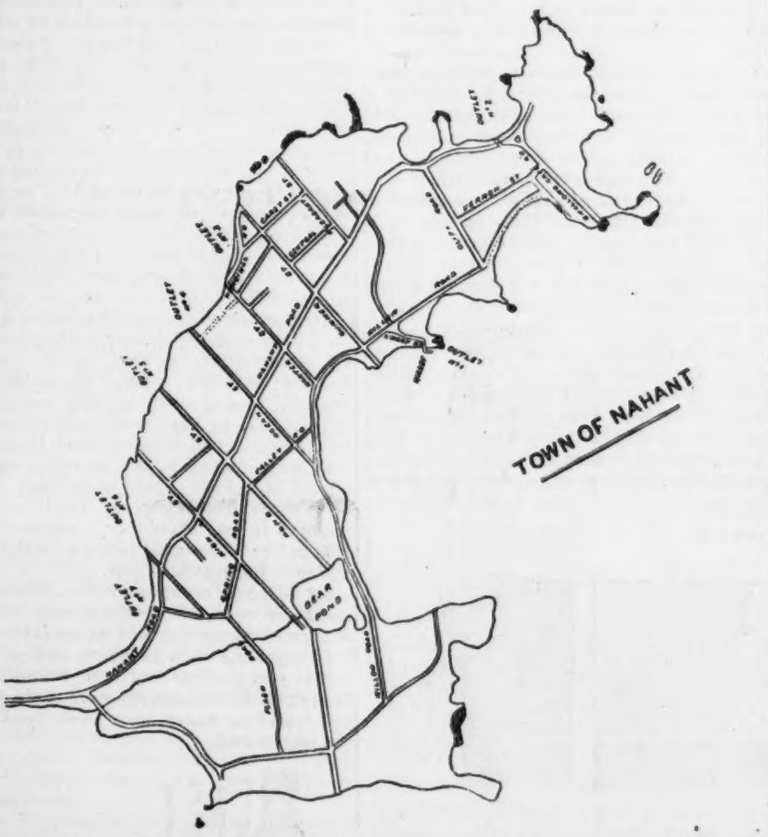
The latter subject so far as the writer's knowledge extends, has never been discussed in print before, and although isolated cases have been noticed where soil was recovered, to greater or less extent, yet it has apparently either been over-looked, or considered as of small moment.

It being determined to construct a system of sewers, the "separate" system was adopted, as less expensive and quicker to build. It was argued that if manholes were placed at all junctions, and changes of direction, whether vertical or horizontal, it would be comparatively easy to flush with water, or clean with rods, chains, brushes, etc.

On questions relating not only to the preliminary selection of materials, but actually constructive work and maintenance, the writer borrowed freely on all sides, and though usually the methods heretofore employed by other engineers answered the purpose at Nahant, occasionally slight modifications and additions were made that seemed desirable.

Particularly was this the case with the apparatus for cleaning the sewers and in the arrangement for the ventilation of both sewer and private drains.

The requisite capacities for the sewers were figured on a basis of the area to be served, the proposed grade for each pipe, the velocity of flow of sewage, in every case, and the quantity of sewage that might be delivered at given points during those hours when plumbing would be in greatest use (between 8 and 10 A. M)



The sizes for pipes, thus determined by calculation, were doubled, so that when in maximum use they would run one-half full. Although many of the lateral sewers, figured on this basis and doubled, should have been four-inch pipes and not larger, the difficulty experienced in obtaining sufficient quantities of pipe of that size, straight enough to admit of inspection between man-holes placed 250 feet apart, was so great, that six-inch pipe was selected as the minimum size.

Actually constructed, the sewers vary in size from six inches to eighteen inches in diameter, and are, so far as possible, laid with tight joints, excluding all ground and surface water. At the present time, the only water purposely admitted to any of the pipes other than house sewage, is the rainfall from the roof of one school-house, that covers an area of 1,300 square feet. This was connected, as that part of the sewer was what is termed a "dead end" and received the sewage from one house only.

It is believed that the pipe system at Nahant represents to-day the only thorough system of separate sewers in this country. They certainly can be pointed to as the only system of separate sewers that are operated without public water of any description, and that in certain sections have only a very limited supply of even well and cistern water. From their method of construction, however, as has been shown, every portion of the system is capable of being, and actually is inspected periodically. Every length of pipe can be examined and cleaned, not only by flushing, but by scrubbing with wire brushes.

When it is desired to flush any line of pipe, a sand bag is used as a plug for the outlet of a manhole, which is then filled with salt water by the town water-cart,—rather a primitive fashion of procedure, but one that it was decided to adopt, temporarily, during the first season, or until it should be demonstrated by actual experiment where flush tanks should be located and what their size should be. As a rule, water enough is put into the manhole in question to make a solid water plug, as it were, for forty feet of the sewer, below the manhole.

The flushing by this crude method has been so successful, and has to be attended to so seldom, that it is quite possible the special flush tanks may be omitted entirely.

During construction, silt, in the form of fine sand and clay, found its way into some of the pipes, and upon completion of the work deposits were found in certain sections; in one case to a depth of over three inches, and very compact. The question of removal seems quite a serious one; the more so, after repeated flushing had failed to cary off the obstruction.

After repeated experiment one of the two following courses was adopted in every case; a shingle with a lighted candle fastened upon it was allowed to float down the pipe from a manhole, being controlled from the initial point by a string, so that it could be stopped when desired. An obstruction could be located by measuring the length of the string. This being ascertained, a hoe or rake was introduced on one end of a series of jointed rods (which when screwed together somewhat resemble a fishing pole), and the sand loosened and afterwards flushed off with water; or, a stout twine was attached to a wooden plug, which was floated down from one manhole to another, and to which in turn, was fastened a small rope and a section of rather heavy iron chain, which latter could be dragged to and fro, until the whole mass of sediment was loosened.

These appliances, except the shingle and candle, are the ones ordinarily in use for pipe sewers and were found tolerably satisfactory, though not wholly so. To meet the want still felt, circular brushes of various sizes that could be attached to a rope or a rod and then pulled or pushed through, were devised; at first, these were made of stiff bristles, but now are constructed of flat steel wires, fastened to a wooden core and with the arrangements before mentioned appear to be sufficient for all purposes. After being once thoroughly cleaned, the question of keeping the sewers in that condition was much simplified.

Inspection now consists either in reflecting the sunlight through the sewer, from one manhole to another, by means of mirrors, which enable a very fair inspection without any flush whatever, or in the use of the shingle and candle before mentioned. If any foreign matter appears to be in the pipe, its position can be located (if the day is sunny) by counting the joints in the pipe, which can be seen by the mirror above referred to, and the brush, chain, hoe or rake used, as may seem best.

The system, which is to-day nearly five miles in length, is intended to be thoroughly ventilated, and includes not only the public sewers, but all private drains below running traps.

The lower manhole on each trunk sewer is provided with a perforated cover, to relieve the other portions of the sewer from the pressure caused by the heavy surf, and not, as has been suggested, as a fresh-air-inlet, for, on the upper side of each manhole, is a flap valve or tide gate which would effectually prevent any such use being made of the perforated cover.

The sewers and house connections above the last manhole on each trunk line (which manhole is intended for the purpose above described) are water-tight, so far as careful work can make them. House connections are entered in 4-inch Y pipes, and the ventilation for both sewer and house drain is provided for by a 4-inch pipe, connecting outside each and every house, extending from the main drain of each building just below the running trap, to some point above the chimneys. (See Fig. 1.) This provides not only for the ventilation of sewer and house drain (the latter is rarely ventilated between the running trap and the sewer, though apt to be fouler than any portion of the public sewer), but it also causes each house

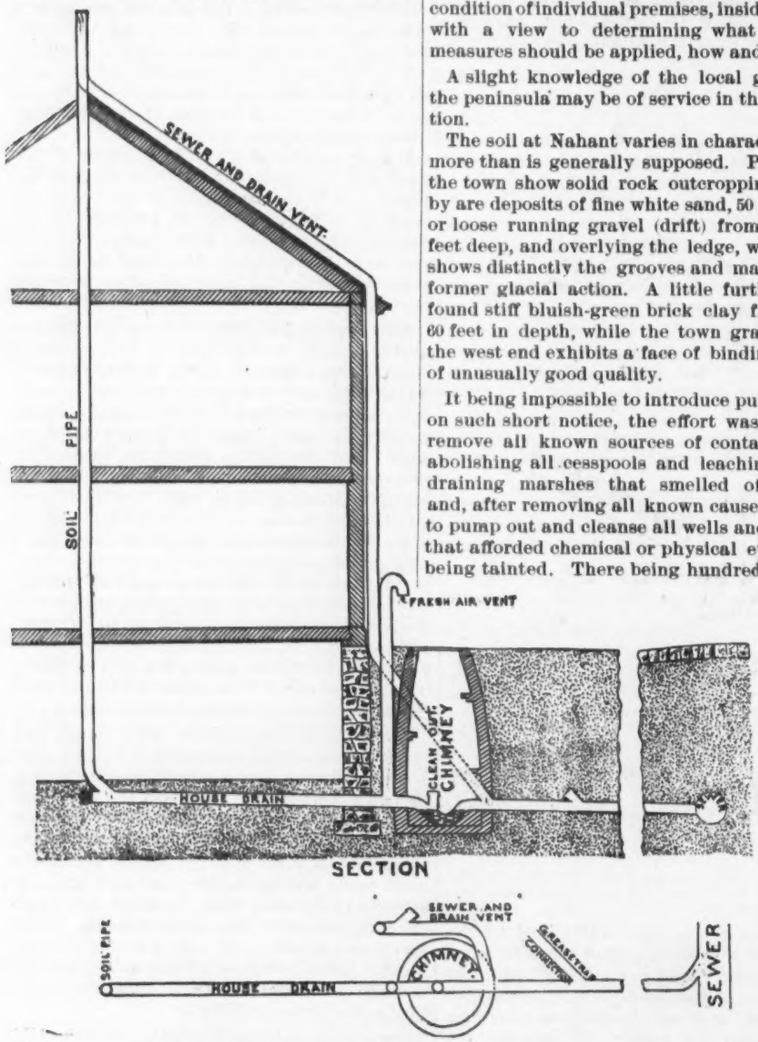


FIGURE 1.

drain to ventilate its proportion of the system, and prevents the usual concentration of the gases at a few points.

All ventilation being above the top of the house, there is very small chance of annoyance from smell, and so far as known there has been none noticed at any point save slightly at the perforated manholes at the foot of the trunk lines, and in three instances from "puffing" of fresh-air inlets to house drains—both of which were disconnected from the sewer and drain ventilation referred to.

Many of the houses at Nahant being provided with privies instead of water closets,—and privies, too, of the poorest possible type,—the plan in annexed cut was adopted (see Fig. 2), as being perhaps more easily attended to than any other and at the same time capable of being used, but not abused.

Any privy whose contents are received in a leaking vault, is undesirable, and when such vault is, as is not uncommonly the case, used as general slop-hopper as well, and the soil in the immediate neighborhood drenched periodically with the family filth, it should always be viewed with distrust.

At such points as seemed permissible, the option was given between the tub set on the slanting asphalt floor, as shown, or a thoroughly cemented shallow vault into which no slops were to be thrown.

The foregoing rather brief description with the accompanying plates may be sufficient to show what was done at Nahant, to prevent further soil pollution. In addition to this, and at the same time, an investigation was constantly going on to ascertain the amount of both soil and water pollution already existing, the general condition of individual premises, inside and out, with a view to determining what remedial measures should be applied, how and when.

A slight knowledge of the local geology of the peninsula may be of service in this connection.

The soil at Nahant varies in character much more than is generally supposed. Portions of the town show solid rock outcroppings; near by are deposits of fine white sand, 50 feet deep, or loose running gravel (drift) from 12 to 25 feet deep, and overlying the ledge, which still shows distinctly the grooves and markings of former glacial action. A little further on is found stiff bluish-green brick clay from 20 to 60 feet in depth, while the town gravel-pit at the west end exhibits a face of binding gravel of unusually good quality.

It being impossible to introduce public water on such short notice, the effort was made to remove all known sources of contamination, abolishing all cesspools and leaching vaults, draining marshes that smelled offensively, and, after removing all known causes of filth, to pump out and cleanse all wells and cisterns that afforded chemical or physical evidence of being tainted. There being hundreds of wells and cisterns used for drinking and cooking supplies, hundreds of chemical analyses were made, in the first instance to determine the general character of the water, and afterwards to ascertain what effect, if any, was produced (after removal of the supposed sources of trouble) by the pumping out and cleaning.

In many instances there was little or no improvement in the quality of the water, in others it was appreciably benefited, and occasionally, so far as could be ascertained chemically, waters were rendered entirely satisfactory, that were previously classed as decidedly injurious.

In the case of cistern water this might be expected in perhaps a majority of cases, and in a measure well water might show change for the better, though hardly to the extent indicated.

There being no public water during the season of 1882, most of the old wells and cisterns were of necessity depended upon for the major part of the drinking and cooking water, although many of the summer residents had spring water delivered periodically.

Of the wells and cisterns examined, nearly 60 per cent. contained water that was classed as undesirable (the proportion of wells and cisterns being about even,

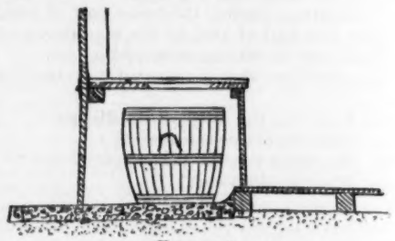


FIGURE 2.

Concisely speaking, there were 80 cases of typhoid fever during 1881, out of an estimated population of 1,500. In 1882 the summer population was probably not over 1,200, and the number of cases can perhaps be best reported in the language of the local board of health, just issued: "It is a source of gratification and pleasure to them (the Board) to be able to report that, notwithstanding the epidemic of typhoid fever that prevailed here in 1881, yet the vigorous correctionary measures adopted by the town, and carefully carried out, completely checked it, and not a single case of the fever has appeared here since, that could not be traced to some other locality, for its origin."

Another statement should be taken into consideration here, which may not be apparent to all, at first sight, but that has an important bearing; naturally, some of the houses where typhoid was present in 1881 were vacant during 1882, so that to understand the condition precisely, and compare them, those houses that were vacant in 1882 in which cases occurred during 1881 should be omitted. Instead of 80 cases, therefore, the total number of patients in 1881 should be considered as 61, sick in houses occupied either a portion or the whole of the season of 1882.

Six instances are shown below, three cisterns and three wells, all of which were examined contained water that was undesirable to use.

Later, when such pumping and scrubbing out as was possible had been thoroughly attended to, fresh analyses were made, as indicated, and the waters were freely used during the season 1882.

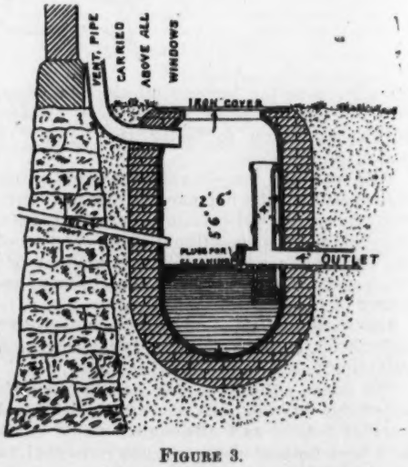


FIGURE 3.

These samples have been selected, from many such, as showing, perhaps more markedly than any others, how it is sometimes possible for polluted water-supplies to recover, appreciably, in a short time, when the sources of pollution are removed.

Numbers of wells and cisterns did not recover, or show any marked signs of improvement that could be detected chemically, and though there are not enough examples on the whole list that occur in the same soil, and

under sufficiently similar conditions, from which to draw general conclusions that can be considered as of very great value, yet it seems as if there was quite enough evidence to show that where isolated cases of typhoid occur that seem directly traceable to drinking water, it is at times possible that the supply may be so improved by simple pumping out and cleaning as to become permissible in quality, and it is fair to infer from knowledge at hand that such pumping and cleaning may actually accomplish more than can be shown by any chemical work, as now done. Unless this last be true, or partially so, it appears scarcely possible that the condition of affairs at Nahant could have improved to such an extent in one season, one during which typhoid fever seemed more than usually prevalent elsewhere.

The first case is that of a well, the water from which is used in a house where fever was present in 1881. Sample taken in December, 1881:—

A.—Free ammonia, 0.0008; Albuminoid ammonia, 0.0070; Chlorine, 22.60; Fixed residue, 72.30; Volatile residue, 17,70; Total residue, 90.00; Hardness, 18°.

The same well during the last of June, 1882, was as follows:—

B.—Free ammonia, 0.0027: Albuminoid ammonia, 0.0082; Chlorine, 10.60; Fixed residue, 41.70; Volatile residue, 9.70; Total, residue, 51.40; Hardness, 13°.

Of sample *A* the chemist report, "A very suspicious water, on account of the large amount of chlorine, residue, nitrates, and high degree of hardness, although the soil appears at the present time to be acting as an efficient filter and oxidizer."

Of *B* the report is, "Suspicious on account of the large amount of nitrates, chlorine, residue and hardness. The small amount of the ammonias shows that the organic matter is at present being oxidized in passing through the soil."

The second case is that of a well in gravelly soil; water used in 1881 where there was fever in the house. Sample taken June, 1882:—

C.—Free ammonia, 0.0086; Albuminoid ammonia, 0.0202; Chlorine, 6.50; Fixed residue, 19.80; Volatile residue, 4.40; Total residue, 24.-20; Hardness, 2½°.

After cleaning, a sample was taken early in July:—

D.—Free ammonia, 0.0008; Albuminoid ammonia, 0.0138; Chlorine, 8,70; Fixed residue, 21.40; Volatile residue, 2.10; Total residue, 23.-50; Hardness, 4°.

A second cleaning was ordered, and a third sample taken the first of September:—

E.—Free ammonia, 0.0005; Albuminoid ammonia, 0.0100; Chlorine, 5.90; Fixed residue, 19.40; Volatile residue, 3.40; Total residue, 22,-80; Hardness, 5°.

Of *C.* the report is, "There is too large an amount of organic matter present, as shown by the amount of both ammonias, the brown color and charring of the residue on ignition."

D. is pronounced "a fair water, the albuminoid ammonia being just within the maximum normal; the yellowish tinge and the blackening of the residue upon ignition show rather too much vegetable matter."

When it comes to *E.* "There is no evidence of injurious contamination, and there is no reason for suspicion as to the future purity."

The third case of a well recovering (if this be the proper term to use) is one not over twenty feet deep and in a running gravel. Supposed source of defilement had existed not less than ten years. First sample taken in November, 1881.

F. Free ammonia, 0.0040; Albuminoid ammonia, 0.0185; Chlorine, 5.40; Fixed residue, 10.50; Volatile residue, 6.00; Total residue, 16.50; Hardness.

The first of February, 1882:—

G.—Free ammonia, 0.0019; Albuminoid ammonia, 0.0074; Chlorine, 5.70; Fixed residue, 14.70; Volatile residue, 2.90; Total residue, 17.-60; Hardness, 2°.

Early in April, 1882:—

H.—Free ammonia, 0.0005; Albuminoid ammonia, 0.0078; Chlorine, 4.90; Fixed residue, 10.90; Volatile residue, 2.70; Total residue, 13.60; Hardness, 1½°.

In July the same water was:—

I.—Free ammonia, 0.0000; Albuminoid ammonia, 0.0008; Chlorine, 6.60; Fixed residue, 28.90; Volatile residue, 11.30; Total residue 38.-20; Hardness, 4°.

Early in October (after heavy rains):—

J.—Free ammonia, 0.0038; Albuminoid ammonia, 0.0098; Chlorine, 5.80; Fixed residue, 12.50; Volatile residue, 5.00; Total Residue, 17.50; Hardness, 3°.

F. is pronounced "unfit for use."

G. I cannot tell whether this is a cistern or well-water. If a well-water it is very soft and good, for Nahant water. If a cistern water, it contains two much chlorine and solid matter.'

H: "A very good water."

I: "An excellent water at the present time. The trace of nitrates, however, together with the considerable amount of residue, gives rise to a slight suspicion as to the future purity."

J: Still an excellent water."

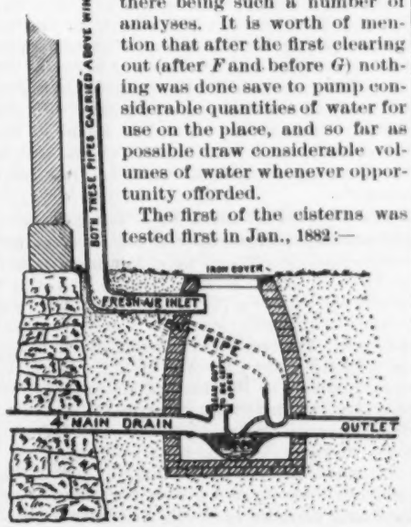


FIG. 4.

This example is perhaps the most striking of the entire list, there being such a number of analyses. It is worth of mention that after the first clearing out (after *F* and before *G*) nothing was done save to pump considerable quantities of water for use on the place, and so far as possible draw considerable volumes of water whenever opportunity offorded.

The first of the cisterns was tested first in Jan., 1882:—

K.—Free ammonia, 0,0098; Albuminoid ammonia, 0.0178; Chlorine, 2.80; Fixed residue, 56.30; Volatile residue, 4.60; Total residue, 60.90; Hardness, 30°.

In February:—

L.—Free ammonia, 0.0013; Albuminoid ammonia, 0.0088; Chlorine, 160; Fixed residue, 8.-30; Volatile residue, 1.40; Total residue, 9.70; Hardness, 3°.

In April:—

M.—Free ammonia, 0.0107; Albuminoid ammonia, 0.0088; Chlorine, 1.30; Fixed residue, 8.90; Volatile, 1.60; Total, 10.50; Hardness, 4½°.

K is pronounced undesirable.

L shows "no evidence of injurious contamination. There is too much chlorine and residue for a cistern water unless located very near the salt water."

M is "slightly suspicious on account of the free ammonia, and if a cistern water, of the chlorine and residue."

Water from the second of the cisterns was used at a house where fatal cases of typhoid fever had occurred. Sample taken early in January, 1882.

N.—Free ammonia, 0.0493; Albuminoid ammonia, 0.0144; Chlorine, 0.90; Fixed residue, 3.60; Volatile, 1.10; Total, 4.70; Hardness, 1½°.

The next one taken in May, 1882 (after heavy rains:—

O.—Free ammonia, 0.0152; Albuminoid ammonia, 0.0098; Chlorine, 1.70; Fixed residue, 3.30; Volatile, 2.90; Total, 6.20; Hardness, 1°.

The comments on the first one, *N*, are "Probably a cistern water, and a very suspicious one on account of the very large amount of free ammonia together with the large amount of chlorine. The albuminoid is about the extreme limit."

On *O* the report is, "Without knowing anything about the surroundings of this water, I

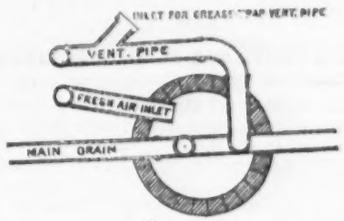


FIGURE 5.

should pronounce it suspicious or even bad, but I think fresh rainwater, collected about the beginning of an easterly storm at Nahant, might have this composition." (The sample *was* collected just after a heavy easterly storm.)

The third instance is a cistern the water from which was used in a house where severe typhoid occurred. The first sample was taken just before the first of November, 1881.

P.—Free ammonia, 0.0195; Albuminoid ammonia, 0.0530; Chlorine, 0.7; Fixed residue, 11.00; Volatile, 10.00; Total, 21.00; Hardness, —.

And a fortnight later:—

Q.—Free ammonia, 0.0750; Albuminoid ammonia, 0.0085; Chlorine, .20; Fixed residue, 3.00; Volatile, 2.00; Total, 5.00; Hardness, —.

P is pronounced "foul and unfit for use on account of its large charge of carbonaceous or vegetable organic matters. * * * It should be called highly dangerous.

Q. "This water is from a sound and clean cistern. The proportion of free ammonia is high * * * and may be accounted for by the entry of recent heavy rains into the cistern, or by the condensation of ammoniacal vapors on the roof from neighboring flues. A satisfactory water."

While the conclusions, as to soil recovery, may be derived from insufficient premises, perhaps calling attention to the subject may lead to a discovery of facts warranting systematic research in this direction that may be of great sanitary value.

Ground was broken for the sewers, February 16, 1882, and all work on them was finished July, 1882, although some of the private connections were not done till after that date.

The estimated cost of the work was $52,000; the actual cost, including a number of items not originally estimated upon, was $41,785.77.

The question has been frequently asked,

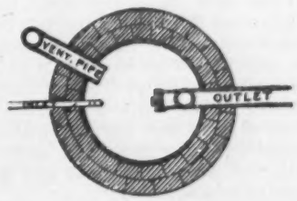


FIGURE 6.

"With the knowledge gained from the work done, what changes would be advised, was it to be repeated elsewhere?" A difficult question to answer, as no two places are similarly situated, either geographically, sanitarily, financially, or any other way. It may be sufficient to say, that some of the details of the house connections, such as grease-traps, cesspools (Figs. 3, 4, 5 and 6), and fresh-air inlets, would probably be somewhat differently arranged, and the former built of cast-iron rather than brick, while the general features of the plan would remain unchanged.

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Mr. G. B. Bruce, Vice-president of the Institution of Civil Engineers, recently visited this country as the representative of that body at the opening of the Northern Pacific Railroad; and at a late meeting of the Institution he gave some account of what he saw as an engineer.

After describing the Northern Pacific road, he remarked that he was especially struck with the bridges upon the line, particularly the Missouri river crossing at Bismarck and the wooden structures in the Rocky Mountains. He complimented American engineers upon their arrangement of work, and the strictly systematic manner in which they carried it forward under very difficult and trying circumstances. He mentioned with wonder the forty-year old cities of St. Paul and Minneapolis with their populations of 80,000 and 90,000 people. He called attention to the more common use of the electric light in this country, and especially in the small prairie towns where lights upon one high pole illuminated the whole place. Our steamboat accommodations were contrasted with the English steam-tug system of transport very much to the disadvantage of the latter vessel.

In conclusion, Mr. Bruce stated that he had been greatly impressed with the extraordinary hospitality of the American people. "In Portland, Oregon, for instance, where there are few hotels, the members of the party were received into the private houses of the citizens and right hospitably entertained, and everywhere they went as opportunity offered they were received in the same way. We always knew that America was a grand and magnificent country; great and magnificent in the extent of its territory; great and magnificent in what it has achieved in the past; great and magnificent in the future which lies before it. We knew all this upon ample testimony, because we had been told it by others and had read of it in books for ourselves. But it required us to cross the Atlantic, to brave all its storms and visit America as the guest of Mr. Villard and the Northern Pacific Railway Company, and the guests of the towns and cities along its route, in order to know as we now most thoroughly do, that America is great and magnificent even in its hospitality."

THE POLE-AND-WIRE NUISANCE.

Hon. Wm. M. Evarts argued last week in the 25th Street case, that the legislative bodies of the State of New York had authorized the Brush Company to stretch its wires upon poles in the streets of New York, and that these authorities were responsible, and that they alone could rescind such power; and also that "presumptively the method of street lighting is above ground. 'No man lighteth a candle and putteth it under a bushel.'"

As we understand it, no complaint is made of the light, but only of the crude and makeshift method now in use for conveying the dangerous electric currents which feed these lights. It is a question of unsightly poles that mar the otherwise handsome streets, and unprotected wires that may at any moment deal out swift and certain death, versus some method more in accordance with the demands of our modern civilization.

If legislation is required to cover and protect these wires it is time some decisive action was taken. When electric lighting was in its experimental stage—on trial in fact—it was perhaps right and proper that these experiments should be made in the least expensive manner; but this stage has been passed, the electric light is an established fact, and its use has demonstrated not only its utility but also its dangerous qualities.

Electricians state that a wire charged with any amount of electricity exceeding 350 volts will paralyze any one coming into the circuit, and an amount exceeding 800 volts will kill, or will fire woodwork with which it comes in contact. The current required for electric lighting falls within the latter category. A common item of news in the New York daily press, in these times, is the last accident to man, beast or property chargeable to these brilliant but dangerous lights, and these items appear with alarming frequency. Last week a runaway horse dashed into and broke down an electric light pole on Fifth Ave., and the horse and its driver were both seriously injured by the electric current; the horse becoming entangled in the broken wires, was so charged with the fluid that no assistance could be rendered the dumb brute until the current was stopped at the Company's works, an interval of two hours elapsing.

The presence of these wires has interfered in a marked degree with the efficiency of our water department; and the one-time brave and reckless fireman now steps timidly over a roof or through a hallway, fearing contact with what to him has in it more elements of danger than the fire itself. Time and again the fire alarm boxes have been rendered useless by the melting of their magnets, to the further endangering of property; we have fires of mysterious origin, charged to the electric light wires; in fact the different phases of danger multiply daily.

We must have the lights, but it is due to the public to cover up and protect the wires from the many dangers to which the daily experiences of a busy city expose them. Put them underground, in conduits under the sidewalks, in subways under the streets; dispose of them in any way that will lessen the dangers of life and property.

The first great cost of such a new departure should not be allowed to defer the movements, for the time is coming, and it is very near at hand, when all poles and wires will be forced from our streets and from our housetops, driven from their aerial position by lack of room for further wires if by nothing else.

Cheap plant and excessive charges to the consumer are too prevalent features of American corporate management. And in this connection, what is called "economy," often proves the most reckless extravagance; a public improvement is started, it may be waterworks, drainage, the telegraph, or electric lighting, and the promoters "economize" by using small pipes, small sewers, wooden poles, cheap material and cheap labor—professional as well as manual labor—and meeting the demands of the moment, congratulate each other upon their success. Time soon demonstrates their folly and the works must be rebuilt; once, if its second installment of managers are wise enough to forcaste the future, twice or thrice, if each set by "economy" repeat the blunders of their predecessors.

It is so with the wire-and-pole nuisance and will be so with the electric light if permitted to grow in the reckless manner of to-day. If the amount of money could be calculated that has already been expended in the city of New York, for poles and wires, their erection and repairs, the restoration of both after every great fire and each winter storm, we feel assured that the cost of a most elaborate conduit system would be far more than met.

The wiry cobweb that covers our city has been a thing of slow growth, and as long as it only festooned the by-ways and out-lying nooks passed unnoticed; but the many isolated webs have been united into a vast obtrusive tangle and now that man has been added to the victims of its meshes, good house keeping demands that we sweep it down.

Transactions of the American Society of Civil Engineers.

The Transactions for September, 1883 contain an illustrated paper upon the "Rebuilding of the Monongahela Bridge, at Pittsburgh, Pa." by G. Lindenthal, originally read at the Annual Convention at St. Paul on June 20th. With the paper is also published the discussion of the subject by Messrs. Collingwood, Egleston and the author, Mr. Lindenthal.

The Proceedings, in addition to the usual minutes of meetings, contains an extended memoir of Ashbel Welsh, late president Am. Soc. C. E.; it is much more complete in the details of his professional life, than the sketch we published at the time of his death from such data as we could hastily gather.

We append a list of the new members elected since September 12, and also a list of changes and corrections in the addres of members, and deaths.

NEW MEMBERS, ETC.—Andrew Bell, Res. Engineer, Carillon Canal Works, Carillon, Canada; Henry I. Bliss, La Crosse, Wis.; Charles H. Campbell (Raymond & Campbell), Council Bluffs, Iowa; William W. Card, Sec. Westinghouse Air Brake Co., Pittsburgh, Pa.; Frank C. Doran, City Engineer, Richmond, Ind.; Geo. Downe, Supt. Motive Power, New South Wales Government Steam Tramways, Randwick, Sydney, New South Wales, Australia; William H. Jennings, Eng'r Hocking Valley Div. Columbus, Hocking Valley & Toledo Railway, Columbus, Ohio; Albon P. Man, jr., 1st Asst. Engineer, St. Louis & San Francisco Railway, St. Louis, Mo.; George A. Marr, U. S. Asst. Engineer, St. Paul, Minn.; Daniel McCool, Chief Engineer, Detroit, Mackinaw & Marquette Railroad, Marquette, Mich.; Wallace McGrath, Chief Engineer, Ohio Valley Construction Company, Parkersburg, W. Va.; John L. F. O'Hanly, Chief Engineer, Ontario Pacific R'w., Ottawa, Canada; George W. Polk, Chief Asst. Eng. International Construction Company, San Antonio, Texas; Watson W. Rich, Chief Engineer Minnesota Central Railroad, St. Paul, Minn.; Andrew Rosewater, City Engineer, Omaha, Neb.; Leonard W. Rundlett, Engineer, Water Commission, St. Paul, Minn.; Henry R. Towne, President and Engineer, Yale and Towne Mfg. Co., Stamford, Conn.; Frederick W. Watkins, 113 East One Hundred and Fifteenth street, New York City; Edward H. Williams, Baldwin Locomotive Works, Philadelphia, Pa.

ASSOCIATES.—Joseph P. Card, President St. Louis Wood Preserving Company, St. Louis, Mo.; George F. Swain, Professor of Civil Engineering, Massachusetts Institute of Technology, Boston, Mass.

JUNIORS.—George B. Francis, 39 Summit Ave., Jersey City, N. J.; Frank L. Fuller, 7 Exchange Place, Boston, Mass.; Alfred W. Trotter, Res. Engineer, Northern Adirondack Railroad, St. Regis Falls, Franklin Co., N. Y.; Frederick N. Willson, Professor of Engineering and Mechanical Drawing, College of New Jersey, Princeton, N. J.

FELLOWS.—Edward P. Allis, Milwaukee, Wis.; Charles L. Colby, President Wisconsin

Central Railroad, Milwaukee, Wis.; Albert Conro, Milwaukee, Wis.; Alexander Mitchell, President Chicago, Milwaukee & St. Paul Railway, Milwaukee, Wis.

CHANGES AND CORRECTIONS.

CORRESPONDING MEMBER.—Charles O. Gleim, (care Baudeputation), Hamburg, Germany.

MEMBERS.—Thomas Appleton, Leavenworth, Kansas; William H. Atwood, Div. Engr. South Penn. L. R., Fannettsburg, Pa.; A. P. Barnard, Kingsville, Mo.; Charles E. Billin, 261 South Fourth St., Philadelphia, Pa.; William H. Bixby, Captain of Engineers U. S. A., 33 West Houston street, New York City; Frank A. Calkins, Arsenal, Central Park, New York City; Allan Cambell, 125 Lexington Ave., N. Y. City; Robert Cartwright, Gen. Supt. Yale and Towne Mfg. Co., Stamford, Conn.; S. H. Chittenden, Corcoran Building, Washington, D. C.; Walter A. Doane, Div. Eng. C. P. R. R., Medicine Hat, North-western Territory, Canada; Charles E. Fogg, Poughkeepsie, N. Y.; Joseph P. Frizell, 7 Exchange Place, Boston, Mass.; Sidney T. Fuller, 12 James Street, Franklin Square, Boston, Mass.; Horace D. Gates, Bernice, Churchill Co., Nevada, *via* Lovelock Station, C. P. R. R.; Henry J. Gielow, Sawyerville, Hale Co., Ala.; Philip Golay, Paducah, Ky.; William P. Harris, White Sulphur Springs, W. Va.; William Hood, Chief Engineer C. P. R. R., San Francisco, Cal.; Gabriel Jordan, Vice-Pres. and Gen. Man. M. & O. R. R., Mobile, Ala.; John W. Kendrick, Chief Eng. St. P. & N. P. R. R., Minneapolis, Minn.; William H. Kennedy, Div. Eng. O. R. & N. Co., Walla Walla, Wash. Ter.; Edward C. Kinney, Lorraine, Ohio; Louis H. Knapp, 280 Linwood Avenue, Buffalo, N. Y.; C. S. Masten, Div. Eng. W. St. L. & P. R'y., Moberly, Mo.; R. E. McMath, City Hall, Room 10, St. Louis, Mo.; J. Albert Monroe, Providence, R. I.; Stacy B. Opdyke, Supt. N. H. & N. Co., New Haven, Conn.; John A. Partridge, Empire House, Buffalo, N. Y.; Orlando M. Poe, Major, Corps of Engineers, Bvt. Brig.-Gen. U. S. A., 34 Congress street, West Detroit, Mich.; N. C. Ray, Asst. Eng. U. P. R. R., Railroad Building, Omaha, Neb.; A. L. Rives, Vice-Pres. R. & D. R. R., Richmond, Va.; Albert C. Savage, Supt. Cons. Mex. International R. R., San Antonio, Texas; William H. Searles, Jersey Shore, Pa. Charles A. Smith, Newburyport, Mass.; Hamilton Smith, jr., (care of Laidlaw & Co.), 14 Wall street, New York City; Isaac W. Smith, Chief Eng. O. P. R. R., New Tacoma, Wash. Ter.: Martin Van Brocklin, Oneida, N. Y.; Hart Vance, Wilson's Point, La.; Henry F. Walling, Topographer U. S. Geological Survey, Pittsfield, Mass.; Wm. G. Williamson, (care Gen. Man. Western Ry. of Ala.), Montgomery, Ala.; Arthur F. Wrotnowski, (care W. H. Sharp), 28 South Sixth street, Philadelphia, Pa.; Samuel H. Yonge, Chief Eng. L. & K. C. Div. Improvement Missouri river, 213 Missouri Ave., Kansas City, Mo.; Edward Yorke, 1526 Tenth street, Sacramento, Cal.

JUNIORS.—Frederick Brooks, 130 Boylston St., Boston, Mass.; George B. Cornell, Asst. Eng., Bridge Dept., N. Y. W. S. & B. R. R., Mills Building, New York City; B. L. Crosby, Rulo, Richardson county, Neb.; Wendell R. Curtis, U. S. Asst. Eng., P. O. Box 133, Savannah, Ga. W. A. G. Emonts, 413 Walnut street, Philadelphia, Pa.; Arthur Haviland, (care of E. Wanzer), Plainfield, N. J.; Sanford Horton, 27 Reynolds Arcade, Rochester, N. Y.; George A. Lederle, Snake River Bridge, Ainsworth, Wash. Terr.; Arthur Macy, Silver King, Pinal county, Ariz.; William Reuschel, Engineer C. C. C. & I. Ry., and I. & St. L. Ry., Cleveland, O.; Alfred Rosenweig, (care Agn. Gutheil & Co.), San Luis Potosi, Mexico, *via* Laredo, Texas; Albert L. Webster, Johns Hopkins University, Baltimore, Md.

DEATHS.—George D. Ansley, elected member September 4th, 1878. Died September 22d, 1883; Redmond J. Brough, elected member Septem; ber 1st, 1880. Died July 21st, 1883; George W. Dresser, elected member July 5th, 1876. Died May 27th, 1883.

LITERATURE.

"MINERAL RESOURCES OF THE UNITED STATES," by Albert Williams Jr., Chief of Division of Mining Statistics and Technology, under J. W. Powell, Director of the U. S. Gelogical Survey. Government Printing Office, Washington, D. C.

This work is an invaluable collection of statistics of the mineral resources of the United States. Coal, as first in importance, very fully treated by Mr. Chas. A. Ashburner, of the State Gelogical Survey of Penn'a., who has submitted a most complete and compact statement of the producing area, the total output and its market value, the chronology of the coal trades, prices paid for labor, etc. Including the local consumption, the total product for 1882, was 31,358,264 tons Penn'a., anthracite, worth $70,556,094; and 60,861,190 tons bituminous and other coals, worth $76,076,487.

The principal Iron statistics for 1882 are as follows:— Pig iron made, 4,623,323 tons spot value $106,336,429. Iron ore mined 9,000,000 tons, spot value $32,400,000. Total iron ore consumed, including 589,655 of imported ore, 9,289,655 tons. Total spot value of all iron and steel in the first stage of manufacture, excluding all duplications, $171,336,429. In making this iron and steel, there were consumed, 3,800,000 tons anthracite, and 6,600,000 tons of bituminous coal, 3,350,000 tons coke, 107,000,000 bushels charcoal, and 3,850,000 tons of limestone used as flux.

For the first six month of 1883 the totals are as follows: Pig iron made, 2,352,019 tons; iron ore mined and consumed, 4,500,000 tons; imported iron ore consumed, 185,000 tons. Total spot value of all iron and steel in the first stages of manufacture, excluding all duplications, $71,000,000.

In 1882, $32,500,000 of gold, and $46,800,000 of silver were mined.

The production of crude petroleum from the oil fields of Penn'a. and New York, amounted in 1882, to 30,053,500 barrels of 42 gallons each, worth on the spot $23,704,698.

The copper output was 91,646,232 pounds, valued at $16,038,091. In 1882, 132,890 tons of lead were produced, worth $12,624,550. Metalic zinc amounted to 33,765 tons, worth $3,646,620. Quicksilver produced, 4,033,998 pounds, valued at $1,487,537. Nickel, 277,034 pounds, worth $304,737. The other metals mined are small in in quantity and value.

Structural materials of course occupy a prominent place in this collections of figures. Under the head of building stone, we find that in 1882, there were 1,525 quarries open; representing an invested capital of $25,414,487. The total product was 115,390,133 cubic feet, valued at $18,356,055. Marble and limestone comes first in quantity with 65,523,965 c. ft., then sandstone with 24,776,930 c. ft., granite and the siliceous rocks, 20,506,569 c. ft., and slate with 4,572,670 c. ft, The only quarries enumerated in the above figures are those producing stone to the value of $1,000 or upwards per year.

The making of the common brick, fire brick, pressed brick, tile, drain-pipe, etc. employs a force of nearly 70,000 persons; and the value of the product is now about $34,000,000 per annum. Pennsylvania takes the lead in product with $5,000,000; New York follows with $4,600,000; Ohio, $3,500,000; Illinois, $3,000,000; Indiana, $2,000,000. The value of the tile made is $2,944,239, principally in Indiana. Drain-pipe figures as worth $1,765,428, in the manufacture of which Ohio leads.

It is difficult, almost impossible to obtain accurate statistics of the lime production in the United States. but it is estimated at from 30,000,000 to 32,000,000 barrels, of 200 pounds each, valued at $21,700,000.

The total cement production in 1882, is estimated at from 3,000,000 to 3,500,000 barrels, worth $3,672,750. 85,000 barrels of artificial or Portland cement are supposed to have been made within the year in this country; 37,793 barrels of foreign cements were imported in 1882.

Suggestions for the Improvement of West St. Louis.

The St. Louis Board of Public Improvements held a meeting Nov. 24, to hear the suggestions of Dr. G. S. Walker relative to improving the roads and streets in western suburbs. The doctor submitted a plan embodying the following features:

All streets and boulevards to contain a drive-way with a foundation laid solid and impervious to water, their surface to be level and six inches below the surface of the sidewalk; streets to be constructed or reconstructed—provided there is no street railroad—shall be proportioned so as to allow only two-fifths for a drive-way and three-fifths for sidewalks, no drive-way to be less than twenty-four feet nor more than forty feet; paved sidewalks are to be laid with Fort Scott stone or other suitable material only six feet wide, with grass-plats on either side for trees, etc.; all sewers, gas pipes, etc., to be placed in alleys whenever practicable, and when not practicable, underneath some part of the plat on the inside of the curb—never underneath the drive-way; all vehicles permitted to drive upon these newly-constructed streets should be compelled to have tires from 2 to 8 inches, according to weight. All street railroads on these streets shall run only on the sidewalks across the grassplat on a 3-foot gauge, and shall run cars not more than 5 feet in width, opening for entrance and exit of passengers on the side next to the dwellings: persons owning property abutting on these streets should pay the expense, and the vehicles, public and private, that exclusively use the drive-ways should be taxed sufficiently to keep them in perfect repair.; all gas pipes should be placed at least six feet under the ground, so as to remove them from the change of temperature, and thus preventing the escape of gas and the killing of vegetation; all the boulevards of the city should be lighted with electricity and not gas.

The members of the board coincided with Dr. Walker in many of his propositions, and after discussing the matter for some time adjourned with the understanding that some of the most practicable suggestions would be adopted.

TRENT CANAL.

The plans and estimates for the Trent Canal, (Canada) will soon be completed and ready for the comming session of the Dominion government.

This canal is to run between Trenton on Lake Ontario and Natchadash Bay—an indentation of Georgian Bay.

The country through which it passes is hilly and in some places rocky. But a great many small lakes, and the Trent river are utilized. Thus the length of the line is about 200 miles, and there will only be about 60 miles cutting.

The Dominion government decided to commence this by making the chain of lakes navigable, and for that purpose locks are in construction at places called Fenelon Falls, Double Pocket, Buckhorn Rapids, (single lock), Lovesick Rapids, (single locks), and Burleigh Falls, (double lock). The cuttings at the last three mentioned places are through granite, which works very hard. These locks will be completed in about two years, when there will be about 70 miles of water made navigable.

This work is in charge of Tom S. Rubidge, C. E., with J. A. Aylmer, as Rresident Engineer.

THE City Corporation of Toronto, Canada, are prepared to grant a lease of a portion of the marsh lands in the vicinity of the river Don for 99 years and exemption from taxation for 10 years, to any company contracting with the city, to establish iron and smelting works, such works to employ 400 men and to invest at least $500,000 therein.

American Society of Civil Engineers.

DECEMBER 5, 1883.

The society met at 8 P. M. Vice President Wm. H. Paine, in the chair, John Bogart, Secretary.

The following candidates were elected members: William A. Drake, Albuquerque, N. M.; Howard Vernon Hinckley, Topeka, Kan.; William S. Lincoln, St. Louis, Mo.; Elbert Nexsen, Stillwater, Minn.; Poulter B. Roberts, Calcutta, India.

The Secretary announced the death on Nov. 25, 1883 of Mr. Arthur Spielman M. Am. Soc. C. E., and the death, on Dec. 3, of Mr. Howard Schuyler, M. Am. Soc. C. E.

A paper by Mr. L. J. LeConte, M. Am. Soc. C. E., describing the dredging operations at Oakland Harbor, Cal., was, in the absence of the writer read by Secretary. The work described was the excation of a tidal basin, and deposit of the excavated material on the adjoining marshes. The machine used was a pump dredge with a cutting apparatus consisting of a horizontal wheel with ordinary plows upon its lower face. The rotation of this wheel makes the excavation. Over this cutter, and partly surrounding it, is a hood, which allows water to enter only from beneath. Over the top of this hood a 20 inch pipe leads up to the large centrifugal pump of six feet in diameter. From this a line of wrought iron pipe, supported partly on pontoons, and partly on the marsh, extends several hundred feet upon the tract to be reclaimed. The material, after leaving the cutter is taken up by the water, passes through the pump and through the pipe to its place of deposit, without at any time during the transportation coming to a state of rest. The engines are two 16x20 inch engines, used exclusively for driving the centrifugal pump, and two 12x12 inch engines for driving the cutting apparatus, swinging the gear, etc. The stream is supplied by two 100 horse power boilers, generally carrying 90 to 95 pounds of steam. The amount of material transported with the water, runs at times as high as 40 per cent. by volume, but experience has shown that in the material excavated at this point which is a blue clay mud, it is not advisable to carry more than 15 per cent. particularly in order to secure a uniform distribution at the place of deposit. The total quantity moved by one dredge in eight months was 250,000 cubic yards. The best work in one month was somewhat over 60,000 cubic yards in 230 engine hours; the average distance of transportation being 1,100 feet. The greatest distance transported was during October when 45,000 yards were deposited in 190 engine hours, through 1,600 to 2,000 feet of 20" pipe. The average daily expense account was stated as approximately $102 but this did not include the cost of the 9 or 10 men on shore, employed to secure a proper disposition of the material, particularly as the fill approaches completion, nor did it include the cost of retaining embankments where required. The result of the work was stated to be, with this one pump dredge, an average of 30,000 cubic yards, measured in the cut at a maximum cost of 10c. per cubic yard, and in one particular month of 23 days work, 60,000 cubic yards were deposited on shore at a distance of 1,600 to 20,000 feet from the dredge at a cost of 5c. per cubic yard. The complete distribution of the material at the place of deposit has been very satisfactory, the result being a cluster of cones whose slopes are very flat,—not more than 1½ per cent. and frequently so slight as to appear almost level. The paper was discussed by the members present.

AN order was passed by the Boston Council authorizing the Committee on the New Cambridge Bridge to expend $1000 in making such preliminary surveys and plans as they may deem necessary.

PERSONAL.

W. C. PERKINS, of the road department of the Mexican Central R. R., committed suicide on Dec. 3. The cause is unknown.

RICHARD F. CLARK, well known in railroad circles, died at Atchison, Kan., on the 29th ult. He came from New York and was connected with the Hannibal & St. Joseph for several years.

COL. GEO. H. HAZLEHURST died in Chattanooga, Tenn., Nov. 25. He was a well-known railroad contractor, and built the Macon & Brunswick, Eufala & Montgomery, New Orleans, Jackson & Great Western, a portion of Alabama Great Southern, the Augusta & Macon, and many other smaller railroads, and at the time of his death was building 200 miles of the Mississippi Valley Railroad.

THE Public Buildings Commissioners of Philadelphia, received proposals on the 4th, for the grading and paving of the sidewalk upon three sides of the Public Buildings. For the putting down of the walk the bids were: Schuylkill Artificial Stone Company, $12,050; Vulcanite Paving Company, $22,000; George H. Woen, $7,350; North Peach Bottom Slate Company, $75,000; J. Maxwell & Sons, $15,000 to $50,000; Standard Artificial Stone Company, $15,075. The bids were referred to a committee consisting of Commissioners Hill, Stokely and Cassin for consideration.

Mr. WIILLAM HOOD is the new Chief Engineer of the Central Pacific R. R., vice S. S Montague, deceased.

Mr. OCTAVE CHANUTE, late Chief Engineer of the Erie Railway, but now resident in Kansas City, where he has large property interests, addressed the Academy of Sciences, Kansas City, on Friday evening of last week, on "The Sewerage System of Kansas City—Past and Prospective."

Mr. DON J. WHITTEMORE, the nominee for the office of President of the American Society of Civil Engineers, is a native of Chittenden County, Vt., and passed his early years in that State, where also he received his education. He began engineering in 1847 on the Vermont Central and Vermont & Canada Railroad, serving until it was completed, and then going upon the Great Western Railroad of Canada, where he had charge of a portion of the construction. He was next occupied on the Central Ohio Railroad from Wheeling to Columbus. He went to Milwaukee in 1853, and since 1866 has held his present position of Chief Engineer of the Chicago, Milwaukee and St. Paul Railway, nearly all of which vast system has been built under his supervision.

Dr. CHARLES S. HASTINGS, son of Dr. P. M. Hastings, of Hartford, has accepted the professorship of physics in the Yale Scientific School.

Col. GEORGE E. WARING and Mrs. Waring of Newport, R. I., have gone to Washington, D. C., for the winter.

WILLIAM KELLOGG, Superintendent of Bridges on the Lehigh Valley Railroad, died at Easton Dec. 1, aged 75 years.

Gen. JEREMY F. GILMER, a prominent citizen of Savannah, died suddenly on the 1st. He was a graduate of West Point and an officer in the old army, and afterward a General in the Confederate army. He was President of the Savannah Gaslight Company and a director of the Georgia Central Railroad.

CORRESPONDENCE.

MEASUREMENT OF ARCH WORK.

Special Correspondence Engineering News.

PHILADELPHIA, Dec. 3, 1883.

EDITOR ENGINEERING NEWS.—If your correspondent at Celina, O., seeking information concerning constructive measurement, will consult Haupt's Engineering Specifications and Contracts, he will find what he wants in chapter on estimates. U. S. E.

PROBLEM IN SURVEYING.

Special Correspondence Engineering News.

PITKIN, COLO., Nov. 30, 1883.

EDITOR ENGINEERING NEWS.—In paper Nov. 24, the solution of problem surveying is answered wrong. The amount is at least 19 acres and a fraction. I would like to get I. A. G. W.'s figures. If it was plotted it would plainly show that 8 acres, etc., was wrong.

Yours truly,
R. A. SKUES.

A HORIZONTAL WELL.

Special Correspondence Engineering News.

PITTSFIELD, MASS., Dec. 4, 1883.

EDITOR ENGINEERING NEWS.—Having to procure water from a hill of peculiar geological formation, I desire to sink a well into the side of the hill in a nearly horizontal direction. Have you any information of any well having been driven or bored in such position? What were the special difficulties and how overcome?

Yours respectfully,
W.

MOVEABLE vs. FIXED CAR-WHEELS.

Special Correspondence Engineering News.

SCRANTON, PA., Dec. 5, 1883.

EDITOR ENGINEERING NEWS.—Will some of your readers give the argument against using a moveable car-wheel instead of a fixed one on the axle. The former kind is in use on the Gravity roads of this vicinity and has worked admirably for a number of years.

Yours respectfully,
A. D. BLACKINTON.

MEASUREMENT OF ARCH WORK.

Special Correspondence Engineering News.

LOWELL, MASS., Dec. 6, 1883.

EDITOR ENGINEERING NEWS:—Your correspondent of Celina, O., in his communication of Nov. 20, asks in regard to the custom of measuring stone masonry.

I am glad that there has been a beginning made as to the customs of measuring work, and hope to see communications from many in regard to the customs of measuring all kinds of work, including stone-work, brick-work, painting, plastering and roofing. I find that contractors will always claim for allowances of every conceivable kind, and as there is no law in regard to allowances, excepting local custom, it is difficult for engineers always to know what to do in justice to both contractor and proprietor. I think that the claim made by the masons for solid measurement on the arch is unjust. There is a certain amount of extra labor in fitting the stone, and if the work is rubble-work and the price was not made for that special piece of work, there ought to be an allowance made in proportion to the extra labor. I should say that the allowance would vary with the size of the arch and the proportion of the span to the spring. I think that if I were called upon to measure the stone in a semi-circular arch of 3½ feet radius, I would allow about one-half of the opening to conform with the custom in this locality. In measuring walls I always allow one-half the openings, where they are small; if larger, say for a basement door 2½ to 3 ft. wide, I would allow one foot by the height of each jamb, to compensate for trouble in laying jamb.

I have had charge of over 200 feet of arch of from 12 to 14 ft. spans, this season, both dry and cement rubble and and have avoided trouble by making an estimate of the number of perches per running foot, before the contract was let, and then letting the contract at so much per running foot.

I would like to ask through your columns for the custom in regard to measuring brick-work when there is a vaulted air space of from 2" to 2½" in thickness, with band every eighth course; whether to allow solid wall or for the actual amount of brick laid; also the custom for measuring chimneys, containing from two flues to a dozen.

Very truly,
MELVIN B. SMITH.

SELECTED MISCELLANY.

Work on the Washington monument is suspended for the season with the shaft 410 feet high, a gain of just 50 feet since last spring. It is now overtopped by two chimneys in Glasgow, one 450 and the other 460 feet high, by the great pyramid, 450 feet high, and by a number of European cathedrals. Nothing on this continent approaches it, but the tower of the new Philadelphia city hall will be 535 feet high when finished, to 550 for the monument.

During the nine years from 1872 to 1881 the city of Paris expended 398,000,000 francs on new public works and 256,000,000 francs in maintaining public works already in existence, the total being 654,000,000 francs.

A complete set of the records of the philosophical transactions of the Royal Society of England presented to Rose Polytechnic Institute, Terre Haute, Ind., by Josephus Collett, President of the Board of Trustees, has arrived there. There are not more than two or three complete sets of the books in this country.

The town of Calais, Me., now keeps local time, New Brunswick railway time, and standard time, and the boys are in much perplexity about the proper time to go to school.

The City Council of Columbus, Ohio, has formally rescinded the resolution adopting standard time as the official time of the city and reverted to the old or actual standard of time.

Sea gulls in large numbers resort to the Central Park reservoirs to feed upon the fish with which the waters abound. Two or three times a year the reservoirs are dragged and the bushels of fish captured are given to the poor people of Harlem.

The newest step decided upon in the work of improving modern Rome is the widening and rectifying of the line of that part of the Corso which is the narrowest in the immediate neighborhood of the Piazza Colonna. And the work will be proceeded with at once, although some objection is made that it will so disfigure and obstruct the Corso as to be fatal to the Carnival revelry.

The completion, a few weeks ago, of the boring of the Arlberg tunnel gives interest to a few statistics of the three great Alpine undertakings of this kind now in existence. In length the Arlberg is 10,270 metres, the Mont Cenis is 12,323 metres, and the St. Gothard is 14,900 metres. For time necessary to make the excavations the figures are the reverse of what the figures for length would indicate them to be. The excavation of the Mont Cenis required 14½ years, that of the St. Gothard required about 8 years, but that of the Arlberg, when the vaulting, the road-bed, and the rails are completed and in their places, will require no more than 4 years.

Exploration of a great prehistoric mound in Kanawha county, W. Va., has revealed some interesting facts. The mound is 85 feet high and covers nearly an acre. By sinking a shaft to the crypt in the centre two skeletons were found, and by their sides several lance heads, fragments and entire vessels of pottery, and a quantity of charcoal. Twenty feet deeper the remains of a temple 12 feet square and 10 feet high were found, its roof being composed of oak logs 12 inches square. In the centre of the temple was a sacrificial altar, and by it another skeleton 7 feet 6 inches long and 19 inches across the chest. It wore a copper breastplate 9 inches square, and had six copper bracelets on each arm, and had four copper bands around the forehead. On the left shoulder were three plates of mica about 8 inches square. At some distance another skeleton leaned against the wall in a standing position.

About twenty miles south of Stillwater, says the San Francisco *Call*, in Churchill county, on the Sand Springs flat, at the foot of the mountain, there is a heap of sand about 100 feet high and nearly a mile across, which sings in the wind and is constantly changing. It is thrown by the wind, which there has a circular motion, into a vast round wall with a hollow in the centre half a mile across, which goes two-thirds of the way to the bottom. It is steep and hard to climb to the top, and on the inside is even more steep—so steep that no one has ever dared to go down for fear that the loose sand would slide down and bury him. There are similar dunes on the Sandwich Islands, on the Hebrides and on the Atlantic coast.

A gentleman in Brussels claims to have contrived a perpetual clock. It was started in the latter city about one year ago, and up to a recent date is said to have been running perfectly. An up draught is obtained in a tube or shaft by exposing it to the sun. This draught turns a fan, which winds up the weight of the clock until it reaches the top, when it actuates a brake that stops the fan, but leaves it free to start again after the weight has gone down a little, and thus the power is restored for keeping the clock in motion.

The novelty of the day in Paris is the electric tramway. M. Simon Philippart, the illustrous bankrupt of Banque Europeenne fame, is employing the leisure furnished him by the process of the liquidation in his last failure, in founding an Anglo-French Metropolitaine Electrique Compagnie for exploiting the Faure system of electric accumulators. This accumulator consists of a box in tarred wood containing five plates of lead cast in open checkers. These checkers are filled in with oxide of lead, minimum, and litharge, and plunged in a bath of water with one-tenth of sulphuric acid. Each bath contains 17½ kilogrammes of useful matter and weighs altogether 30 kilogrammes, say 66 pounds. In a shop on the Boulevard Montmartre this stored electricity may be seen applied as a motive power to all kinds of small machinery and to lighting, and at certain hours of the day electric tramways run on several of the lines. The company profess to provide the unit of electric horse power at a cost of ten cents an hour. This would make a tram car cost $7.40 a day, whereas with ordinary horse power it costs in Paris $13 a day. The Faure accumulator loses about half the electricity put into it by the storing process, and it has the disadvantages of adding greatly to the weight of the tram car, and consequently to the wear and tear of the rails. However, here is the fact: we actually have electric tramcars running in Paris.

THE MANUFACTURE OF GLASS.

From a review by *Engineering* of a recent treatise entitled *le Verre et le Cristal*, by M. J. Henreiaux, Assistant Director to the Glass Factories of Saint Gobain, we clip the following notes about glass: The operation of tempering consists in immersing the glass when heated to redness, in a bath of a given temperature. Water is entirely unsuitable for the purpose, and only perfectly pure grease or oils give a good result. A mixture of three-fourths of linseed oil and one-fourth grease is very satisfactory, but it must contain no impurities, and improves in quality with age and use. The temperature required ranges between 150 deg. and 300 deg. Cent.; glycerine also is well adapted for the purpose. The oil is kept at the required temperature in cylindrical iron vessels which can be moved conveniently, and the objects are placed in light iron wire baskets immersed in the oil. After being brought to the required heat and plunged in the bath, the latter and its contents are removed on suitable trucks to a cooling room, where after four or five hours the temperature falls to about 40 deg. The glass objects are then removed, and kept in a stove at a temperature of 70 deg. Cent. for about two hours, by which time all the oil clinging to them has run off. They are then immersed successively in a bath of water saturated with caustic soda, and heated to 60 deg., in a bath of water at 50 deg., and lastly in another water bath of air temperature. The actual cost of tempering appears to be .025 franc for drinking glasses; .030 franc for glass chimneys; .050 franc for lamp globes. The above particulars refer to crystal; for glass the process is somewhat different, and more costly, since a much higher temperature of bath is required, and there is considerable loss by evaporation.

Enamel is a colorless glass holding within it an opaque body in suspension. It is employed for mosaic work, the decoration of clear glass, of porcelain, and of metal, the latter under the form of cloisonne. Strass is that species of glass used in imitation of precious stones; it is so called from a jeweller of the same name, who at the close of the last century became famous for making glass rich in lead.

Glass mosaic work is a very ancient art, and was practiced by the Egyptians, Greeks, and Romans. As early as the fourth century it became the favorite modes of decorating religious edifices, Mohammedan and Catholic, and the taste has never been lost, while to-day it bids fair to be actively revived. The new cathedral of Marseilles is one of the finest examples of modern work. M. Salviati, who makes a specialty of the smalte or enamel employed for mosaic, states that no less than 30,000 shades of color are produced by him. The mosaic worker has a colored original from which he works, and he prepares his enamel, which is supplied to him in discs, by breaking them with a suitable hammer into pieces of about 1 centimetre square. A shallow tray of zinc large enough to enclose the picture to be reproduced is filled with plaster-of-paris carefully levelled, and on the flat surface the original drawing is copied. The artist then proceeds, by means of a sharp-pointed tool, to remove the plaster in small pieces, and to replace it gradually by fragments of enamel, laid evenly with great care, fine plaster being introduced to fill up any small cavities. In this way the work slowly proceeds, and when finished a sheet of strong paper is glued to the face of the mosaic picture. The zinc tray is then reversed and removed, leaving the backs of the pieces of enamel exposed. These are bedded in a thick backing of cement of lime and puzzolana, and when set the panel is ready to be put in place after the paper has been removed and the face cleaned down.

Crackled Glass.—This, which has of late become much in vogue, and is deservedly a favorite, is produced by passing the hot globe from the blow-pipe over a plate of iron covered with minute fragments of broken glass, and causing it to adhere. After reheating the object is finished by the ordinary means. Cotton Glass.—This is obtained by projecting a jet of high-pressure steam or air against a surface of liquid glass, which is carried off by the current in sheets of extreme thinness. This is quite a new product, and, according to the author, appears called on to receive numerous applications. Lamp Wicks.—In Germany, wicks of spun glass are largely made, and present considerable advantages over cotton for the lighter oils or for alcohol. They are cleaner, more durable, and give a pure light.

WORKING WHERE THEY CANNOT SEE.

The conversation turned upon divers in the office of Mr. Lowe, the wrecker, in Coenties Slip, and the reporter of *The Sun* ask some questions. He first wanted to know what about the diver who offered to bet $1,000 that no other diver in New York could beat him walking under water.

"Well," said the person spoken to. "I believe there are a dozen divers in New York that could do as well as he can, but there's no place to walk anywhere's around New York. It's all mud or else it's all rock. The whole East River is all rock, big rough rocks just like what used to be on Manhattan Island before they were blasted away. That point of rocks below Blackwell's Island runs under water all the way to Market street. Whatever mud there is in the East River has drifted there. All the rest of the harbor has a mud bottom. A diver sinks into it just as he would in any mud anywhere. What does he do? He does the best he can, that's all."

"But the mud roils and prevents his seeing."

"Well, a diver can't see anywhere around New York. I've known of it being so clear in the Erie and Atlantic basins that you could see the figures on the copper on a vessel's bottom, but you can't see anything anywhere else around here, if you can there. The water keeps stirred up, and gets no chance to rest. That don't make much difference. A diver trusts to his sense of feeling, and when a diver makes a report on the condition of a vessel her owners will find it just as he says when they get it up out of water. He goes all over a vessel's bottom with his hands, and he can nail copper on her just as well where he can't see as he could in open daylight."

"What different sorts of work do divers do?"

"Well they lay sea walls, blast rock, build piers for bridges, repair vessels, tear up wrecks search for dead bodies, recover things that have fallen overboard, and do anything that is to be done under the water."

"Is it a dangerous business?"

"It is and it isn't. It is easy for a diver to be killed, and yet few do get killed. George Seaman cut his hose by accident while at work on the sloop Troubler not long ago. He died of course. If one's hose bursts or gets cut a man's gone. His wind is stopped. The hose bursted on a man named Jenkins, off Governor's Island, not long ago, and a diver died in Boston a few years ago, and was said to have committed suicide by hanging himself while at his work. There are fifty or sixty divers in New York, but you seldom hear of an accident."

"Do whales, or sharks, or sword fish or marine animals of any sort, attack divers?"

"Not in these waters. There may be such experiences in the tropics. I've read of such things, but we've done lots of work at sea around here, and have never known of such a thing. The other way a diver might die besides having his hose cut or burst, is by having a vessel roll over on him while he is under it, but they generally manage to get away.

THE CULEBRA; OR THE GREAT CUT ON THE PANAMA CANAL.

Translated for Engineering News, from Ge'nie Civil.]

About one kilometre above the village of Matachin, the line of the canal leaves the Chagres river and follows the valley of its tributary, the Obispo, passes over the summit of the Culebra and decends on the Pacific slope by way of the valley of the Rio Grande. This latter valley is elevated and very rugged in surface as far as the village and little river of Pedro-Miguel.

The great Culebra Cut runs from kilometre 45 near Matachin to kilometre 59.5 near Pedro-Miguel. The principal dimensions of this enormous excavation are,

Length	47,560	L. ft.
Maximum depth on axis of Canal	461	ft.
" depth at top of slope	492	ft.
" width at top of cut	984	ft.
Cubic contents, about	80,000,0000	C. yd.

Here, more than anywhere else, the questions of time and money become one. It is evident that the Panama Canal will be unproductive until the Isthmus is cut through from ocean to ocean; and as long as the great trench remains unfinished, the work done on the inferior portions of the Canal will yield no return; and to the actual cost of the excavation at these lowest points must be added the interest upon the sums expended in their execution until the canal is finished. Thus it will be seen that there is no real advantage in pushing the lesser work, but rather to concentrate all the forces upon the big cut.

This question of "concentration of force" at this one point may be defined as follows:—

As to the conditions of economy and energy it is requisite that the height of the bank to be excavated be in proposition to the type of excavating machinery used. For steam excavators this height is about 16 ft. It also follows that if the excavators work laterally, the face of the bank should be long enough, so that it will not be necessary to continually drag back the machine. A wedge should be pushed forward wide enough to contain the excavator and a track for the cars.

As this wedge advances it becomes in time wide enough to permit the use of a second machine, then a third, and so on. The excavations will thus assume the form shown at Fig. 2.

If the excavation is in rock, the general arrangement will remain the same; except that for the excavators will be substituted moveable derricks for the purpose of loading the blocks upon the cars, and instead of the lateral excavation the cutting will be straight ahead, so that the circulating of the trains may not be interrupted by the blasting.

To assist in removing the material, and to also drain any water struck the excavation, an ascending grade should always be preserved; this grade should not be less than about one in thirty.

As the workings will be upon different levels a bench should be maintained on the higher level to carry off the water, and to serve also for moving material.

There are some objections to this general system. In the first place, by removing the material from each separate cut, by a road leading to a point where that level cuts the natural surface, requires a long haul, especially upon the Atlantic slope. But the length of haul is not so much dependent upon the system of working as upon the necessity for depositing this material at certain points. The mass of the excavation on the Atlantic side must be used in the construction of the Chagres dam, near Matachin, close to the Eastern end of the great cut. Only the superficial excavation will be used in filling up the ravines near the point of extraction, and in preparing the banks of the Canal for the company's plant.

In the second place, it may be objected, that the lower workings have no point of beginning, since they strike below the level of the valleys of the Chagres and the Rio Grande. But it is to be hoped that within the next two years the level of these valleys will be sufficiently lowered on the line of the canal, that it will be possible to remove the debris by the canal, itself, depositing it first upon barges and then upon the banks of the canals by the chain of endless buckets provided for such cases. If these means be found insufficient, the natural surface can be reached by a series of inclined planes.

As to the trench of the canal itself, this will be excavated, according the nature of the soil met with, either by dredges, or by blasting in the dry between dams.

The last objection relates to the question of administration or management. The excavations by different levels must advance at such a rate that they will be neither overtaken by the lower level following, nor run into the higher level ahead. The tracks must not conflict with each other; and the water found upon each stage must be so controlled that it cannot interfere with the working on a lower stage.

The programme just given was originally traced by M. M. Couvreux and Hersent; the director general who has succeeded them will have the honor of putting them into practice, and assuring their execution.

The application of this programme should result as follows: The excavation of each stage, containing on an average 3,300,000 C yds., will require about two years. If the advancement of each stage on the one following it represents a labor of three months, for example, and there are twelve stages to remove, it is evident that the last will be finished thirty-six months after the first; and the whole excavation in about five years from the effective commencement of the work. The date of 1888, officially announced by M. Ferdinand de Lesseps for the inauguration of the canal, is thus justified.

If, on the contrary, each stage was removed in succession, working from the top downward, twelve times two years, or twenty-four years would be required to finish the excavation of this great cut.

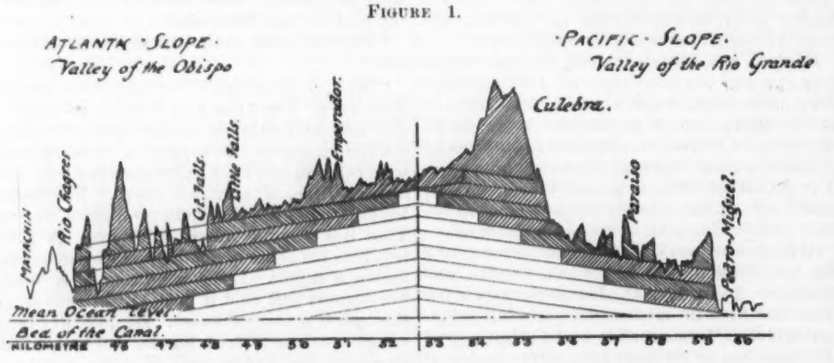
Whatever may be the coefficient of correction applied to the figures we have adopted as a basis for our calculation, the relation will remain the same between the two methods.

The works executed to the present time do not yet demonstrate the rate of progress required; they are confined to the excavation of the higher levels, which cut the natural surface at a great number of points, thus affording many points of attack at different elevations.

The neighborhood of the Great Cut is divided into five sections, which are not only administrative divisions, but are also geographical division.

They are: The Obispo Section, the Emperador, Culebra, Upper Rio Grande and Paraiso.

FIGURE 1.



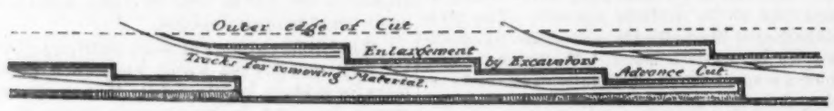


FIGURE 2.

To arrange the workings so that the greatest number of excavations can be carried on at one time, with economy and energy.

The first condition, that of working simultaneously at a great number of points, requires that the pits shall not be located one after the other, but rather in trenches lying one above the other, each with its point of beginning upon the natural surface.

If we examine the profile (Fig. 1), and leave out of consideration for the moment the central mass of the Culebra, and suppose the excavations are commenced at elevations differing 16½ ft. from each other in depth; and advance these cuttings at the same rate; we will notice that they preserve their respective distances, and each will always find in front of it a mass of material of constant height, uncovered by the working of the layer just above.

By applying this method of working to the Culebra, the profile will be transformed into a series of steps, corresponding to each other in length. Before this can be done the peak of the Culebra and the leser summits must be first removed.

THE PANAMA CANAL.

Correspondence "N. Y. Herald."

PANAMA NOV. 24, 1883.

I frequently wonder if shareholders really believe that the canal will be cut by 1888. If so, they know little about the work. I note that M. Dingler has recognized the force of remarks published by the *Herald* some months ago, in which lateral canals were declared a necessity, and pointed out the error of believing it possible to build the canal without locks. The directory has determined to build the lateral canals and three locks at Panama. M. Carre, who prepared all the plans in the Chagres dam, has been discharged, much to the surprise of the old employes.

Shareholders are treated to a picture of work on the canal in the *Bulletin du Canal*, published in Paris on October 15. It is said to represent work at Emperador, when it is in truth a patchwork picture made up of scraps of work from sections many miles apart. I recognize in it a little piece of Gatum, a part of Bas Obispo, where work was commenced long ago and then abandoned, and the ballance may be a coal mine somewhere, but it certainly is not on the isthmus. Will shareholders consider this exhibition as entirely fair?

M. Dingler still adheres to the necessity for the Chagres dam. He evidently refuses to believe that the detritus from above will fill it up; believes the water of the river can be easily divided between the Atlantic and Pacific

slopes, and apparently ignores that the day the waters of the Chagres are diverted toward the Pacific, on that same day, by a hundred different courses, those waters will find their way into the River Grande, which they hope to employ for their canal on this side. M. Dingler might learn a lesson as to the effects of the streams if he were to visit California, where hydraulic mining has covered so many miles of ground with dirt. What would become of the big Chagres dam if an earthquake were to crack it ever so slightly? What would become of the Atlantic half of the canal, with its ships and villages? Dams cannot be easily built to retain one thousand cubic metres of water; and the labor is intensified when it has to be performed by a formation such as that of this isthmus and in lands subjected to cracking through earthquakes.

It is also a matter interesting in a financial light, that all the material with which this dam is to be built has to be pulled from a low level through a country in which there are few facilities for railroad building. Excavation will have to perform the greater part of the work. Dredging cannot be profitably conducted except in the short sections where the banks of the canal are but a trifle higher than the stream itself.

Laborers continue to arrive by the thousand, and, although it is the rainy season, by task work succeed in earning from $2 to $2.50 a day. This has led to several strikes by the dock and ship laborers, who have gradually worked their earnings up to $1.75 silver per day. There is an accumulation of labor on the Isthmus from all parts of the world, and, as there is nothing approaching government or police, it is feared that some day serious rioting will occur which will throw into the shade that of last year.

The Panama Canal Company has issued a notice stating that three fresh contracts have been made for cutting portions of the canal.

CEMENT FOR IRON WORK.

Sometimes it is advisable to fix two pieces of iron, as pipes for water or steam, firmly together, as a permanency. A rust cement is frequently used, and the materials are sal ammoniac, sulphur and iron borings. If the cement is desired to fact quickly, he proportion should be: Sal ammoniac, 1 part by weight: sulphur, 2 parts; iron borings, 80 parts. If plenty ottime can be allowed for setting, make the proportions: Sal ammoniac, 2 parts; sulphur, 1 part; iron borings, 200 parts. The sal ammoniac and sulphur should be pulverized, and the borings of cast iron, tolerably fine and free from oil. The mixture should be made with water to a conveniently handled paste. The theory of its action is simply union by oxidation.

WATER, GAS AND STEAM.

THE Texas Water and Gas Company, of Tyler, Texas, has secured the contract for building the water-works of Cleburne, in that State.

THE Monongahela, Pa., Water Co. has just placed a 3,000,000 gallon Worthington pump in their works. The Brookville, Pa., Water Co. has just started a pair of 3,000,000 gallon pumps. Elevation, 260 feet.

A NEW public well at Sandwich is only twenty-five feet deep and is flowing a thousand gallons a minute.

E. P. ALLIS & Co., of Milwaukee, have been awarded the contract for the new Omaha pumping engines.

AT A special town meeting in Reading, Mass., on Wednesday evening, the Committee on Water Supply presented majority and minority and minority reports. The estimated cost was from $134,560 to $86,000. After a long debate the committee's report was accepted and placed on file. The town refused to appoint a committee to secure the passage of an act authorizing the town to procure a water supply.

REPORT OF MASSACHUSETTS WATER BOARD.

From the Fourth Annual Report (1883) of the Massachusetts State Board of Health, Lunacy and Charity.

1. With very few exceptions, companies and water boards have derived their names from the cities or towns in which they are located. This custom has the obvious advantage of fixing upon each organization a definite local status, which, in the matter of financial standing, has a decided advantage. One company has found it of sufficient importance to obtain a special act of legislature, whereby its name is changed from its ancient Indian title to that of the town in which the company is located.

Forty-four boards, so far as can be ascertained, are chosen by cities and towns as supervisors of their public water supplies. The remaining twenty-seven organizations are private corporations mostly chartered under State laws.

Under existing laws many of these companies are empowered to transfer their rights to the various municipalities in which they are located, and hence the number of private companies will be lessened in the future.

2. The sources from which water-supplies are derived in Massachusetts may be classified as follows:

(a. Lakes and large ponds or reservoirs, either natural or artificial.—There are thirty-nine cities and towns using such sources for water-supply. Fortunately the Commonwealth is supplied with ponds or lakes, quite uniformly distributed, a catalogue of which may be found in the Fourth Annual Report of the State Board of Health, p. 117.

In several instances artificial reservoirs have been made by constructing dams across small streams, either in meadows or in rocky gorges, as at Winchester, Arlington, Milford, and at Birch Pond Brook in Lynn. In some instances the area of natural ponds has been largely increased by dams, as at the Upper Mystic Lake of the Boston supply.

The water-supply of Boston belongs both to this class and the following, its supply being derived in part from the Sudbury river by way of storage reservoirs.

(b.) Rivers. — Although several cities and towns having water-supplies are situated directly upon the banks of the two large rivers, the Connecticut and Merrimac, yet in one case only does a city or town take its supply directly from the river. The cities and towns along the the banks of the Connecticut are nearly all supplied by gravitation, and obtain their water from elevated sources among the hills.

Two cities upon the Merrimac use the water of the river, partially through filtering galleries having direct connection with the river, which can be opened in case of emergency.

(c.) Brooks, springs, or small mountain streams not liable to pollution.—Twenty cities or towns obtain their water from sources of this character, and with one exception the water thus supplied appears to be of excellent quality. In consequence of elevated source and remoteness from habitations they are liable to contamination at present. Fourteen of these water-supplies are west of the Connecticut river.

(d.) Filtering Galleries.—Nine water-supplies including the two named in class (*b.*), are furnished through the medium of filtering galleries, or wells, usually constructed along the banks of some stream, or river, with an intervention bank of gravel or other filtering medium of variable thickness. One such filtering well is constructed upon the bank of a pond, whose waters are excessively foul from the sewage of several tanning establishments. The water, however, as received from the well is of unusual purity, the claim having been established, that the water of the well comes from the neighboring hill and not from the pond. A direct pipe leads to the pond, for use in case of necessity, but has never been used since its construction, ten years since.

(*e.*) In two towns the supply is obtained from tubular wells driven into the ground. These have thus far proved adequate to the demand made upon them for a sufficient supply of good water. The city of Lynn also derives a portion of its supply from a similar source.

3. The areas of water-sources may be found by reference to the tables. The supply of Fall river has the largest water-surface in the State, 5.43 square miles. The total area of Boston's supplies amounts to 1,700 acres, and the town of Webster 1,280 acres. At the other extreme, some of the mountain springs used by the villages of western Massachusetts have an area of but a few square feet.

4. The area of water-sheds also presents a wide range of variation in extent. The largest (that of the Merrimac river) includes one-third of the territory of New Hampshire, some 4,136 square miles. The smallest reported, that of Nantucket, a water-shed entirely of drift or alluvium, is estimated at 25 acres.

The tubular wells can hardly be said to have a water-shed, since they are not materially affected by rainfall.

5. The location of water-sources, with their water-sheds, in the western counties, especially in Berkshire, is much higher than the general level of the towns and villages supplied, and hence quite free from the ordinary sources of water-pollution. The water-sheds in that section of the State are mainly forest lands, underlaid with rocky foundation, the higher slopes being mostly uninhabited and uncultivated.

In the middle and especially in the eastern counties are to a greater extent inhabited and cultivated and not unfrequently subjected to decidedly objectionable sources of pollution.

In Barnstable county, there is as yet no water-supplies, either public or private, the want of elevated sources rendering a supply by gravitation impossible for any town.

6 and 7. The estimated capacity of sources, by daily average flow, and by minimum flow may be ascertained by reference to the tables. The capacity of the Merrimac river is estimated at Lawrence as thirty-eight billions of gallons per day. That of the town of Kingston is ten thousand gallons. The minimum capacity is not so fully stated in the returns, but has a similarly wide range of variation.

8. The replies to question eight are mainly in the negative; the chief exceptions being the water-sheds of the Boston supply, that of the town of Woburn, and those of cities and towns upon the banks of the Charles river.

9. Water-sources are used jointly as supplies only in the more densely populated portions of the State. The city of Boston supplies several of its suburban cities and towns. Lynn furnishes water to Swampscott and East Saugus. Salem supplies the town of Beverly. The towns of Medford and Melrose and the city of Malden are fortunate in obtaining a joint supply of good water by gravitation.

10. *Other available sources of supply.*—Massachussetts, has already shown in previous reports of the State Board of Health, has a multitude of lakes and ponds still unused for water-supply. Some have an area of several thousand acres, as in the great ponds of Middleborough.

A few returns have indicated such other available sources as are within a convenient distance of their present water-works.

11. Fortunately, the elevation of most of the water-supplies above the level of towns and villages, as well as their remoteness from them, gives them an immunity from pollution, either from dwellings or manufactories. The larger cities, and especially Boston, are constantly threatened with danger, to prevent which, more efficient legislation is imperative. In the case of water-supply for a position of its inhabitants (Turner's Falls), the public sewers have their outlet into a marsh which has direct communication with the Connecticut river at a point a few rods only above the inlet pipe of the public water-supply.

12. Analysis of the water of the principal water-supplies have been frequently made, and in a few instances, when not stated in the returns, we have quoted such recent records as could be obtained in the files of this office.

In future triennial returns of this nature, the work would be simplified for the purpose of comparison, by a requirement that all chemists or analysis should conform to a standard form of analysis to be adopted by the Board.

It is especially desirable that the old, variable and inaccurate term "gallon" should give place to the more accurate and universally adopted "parts per 100,000."

MAGAZINE RIFLES.

The question of arming our troops with a magazine rifle is one on which considerable difference of opinion exists. As regards infantry, the problem may be stated thus. Is extreme rapidity of fire for certain circumstances of such importance that, in order to gain it, a sacrifice of accuracy of shooting may be permitted?

The construction of a single-loader rifle is dependent on a large number of carefully ballanced considerations. It has been said that the bullet governs the rifle, and we know that for good shooting the bullet must have a certain proportion of length to diameter, and, likewise, a certain weight to get range; behind the bullet as much powder is placed as is consistent with obtaining a supportable recoil, so as to get a flat trajectory and, lastly, the whole rifle is made as light as possible consistent with strength, so as to lessen the weight to be carried, and to give greater ease of handling, and, consequently, accuracy of fire. It will be evident on consideration that the ultimate factor in the question on which everything has to be based is the average strength of a soldier, his power of carrying the weight of his rifle without undue fatigue over long distances, and of supporting the blow of numerous discharges of the weapon; the task of the designer of the rifle being to obtain as much power, range, accuracy, flatness of trajectory and penetration, as possible within the limit of weight imposed by the average muscular power of the man.

All these points have been established by prolonged trials, and furnished a standard by which any proposed change must be tested. The form of rifling, description of breech mechanism, nature of powder, bullet, and cartridge used, are merely secondary, though often very important points on the question. Magazine rifles exist as rule in two forms; either a magazine of cartridges is fixed in the rifle itself, or the magazine is carried by the soldier and is capable of being quickly attached to the rifle, in both cases necessitating extra fittings and additional weight on the rifle.

The condition under which the highest excellence in a rifle is obtained are, however, so nicely arranged that it is impossible to alter any of them without introducing a serious disturbance in the other qualities of the arm. With a magazine rifle the additional weight is a serious consideration as regards accuracy of aim, as it makes the weapon more cumbersome to handle, and the balance is constantly shifted as the magazine empties. The detached magazine, capable of being applied when wanted, presents the sole advantage over the other of lessening the weight on the man's shoulder during the march.

No doubt there are occasions in warfare when it is exceedingly useful to be able to discharge a rifle several times without reloading, but it must not be overlooked that to enable this to be done some sacrifice must be made of the qualities which could be given to the weapon were it a single-loader, and of the ease and accuracy with which the soldier can handle and fire it. In other words, to gain rapitity we must loose accuracy. Putting aside extra cost and complication of parts, it will be seen that gun for gun a magazine rifle cannot be made to compete in shooting with a single-loader of the same weight. The extra weight of the magazine and fitting can in the latter weapon be turned into range, accuracy, or flatness of trajectory. Firing as a single-loader, the magazine rifle is clearly inferior to the other. The sole advantage, therefore, is that of being able for a given time to fire rapidly without reloading, and we may ask what is the least number of rounds it should be capable of firing consecutively so as to justify its designation as a magazine gun? The seventeen or eighteen shots which are at present to be obtained from certain magazine rifles do, it is presumed, lead to such a serious derangement of the general qualities of the weapon, that proposals to adopt magazines with from five to ten rounds have been made, but considering that there are many forms of single-loaders which can fire, when pressed, eighteen to twenty shots per minute, it becomes a question whether the capability of firing five, or even ten rounds without reloading, would prove of such advantage that it is desireable to make sacrifices in accuracy, range, and trajectory to secure it.

The lighter the rifle the better the shooting. On the Continent the diameter of bore almost universally adopted is .433 in., whereas in England our Martini's have a .45 bore. Trials made with even a smaller bore than .433 in. have shown that very good results can be gained, with a reduction in the weight of the arm. It is to be hoped that if any change is to be made in our national arm it will not be in the direction of increased weight.—*Engineering.*

CHIEF ENGINEER LUDLOW'S SALARY.

CHAIRMAN Clay, of the finance committee, received the following letter on the 5th from Chief Engineer of water works Ludlow:

The question of my compensation as the head of this department has reached a point where it becomes necessary for me to interpose. The ordinance to fix the salary at $10,000 was introduced without my knowledge and, presumably, because this was believed a proper compensation ror the duties and responsibilities of the office. The bandying about of a matter of this sort from committee to committee and finally to the secret caucus of a sub-committee strips it of all dignity and make it as utterly repugnant to my sense of fitness or decency. I accepted this office to do such work solely in the interests of the tax-payers and water-consumers of Philadelphia as my best abilities and resources placed in my hands should enable me to do, and I prefer to be judged according to my work. I have no favors to ask from anyone and no gratuities to accept, whether at the hands of individuals or of Councils. I therefore request that in reporting your bills for appropriations to the departments you will pass over any changes that have been proposed in my salary and leave it as if now stands. I trust, however, that the carefully considered adjustments in the salaries of certain subordinates, as recommended by me to the water committee and by them approved, will be adhered to.

IT IS asserted on good authority that H. H. Porter, late president of the Omaha, is interested in a project to build a road from Ordway, Dak., to Bismarck, and the Rock Island management intend to enter this line from Worthington to Ordway, forming a continuous link from Chicago to Bismarck under the control of the Rock Island. It is an open secret among railroad people that it has long been a favorite scheme with R. R. Cable of the Rock Island to build northwest from Worthington into Dakota, and it seems probable enough that next year will see the road begun which is to invade the territory, both of the North-western & St. Paul and of the Northern Pacific.

Construction Notes.

WORK has been commenced on several of the large tunnels of the South Pennsylvania Railway which is the Vanderbilt line that is to connect Harrisburg and Pittsburgh. No. 1, or Blue mountain tunnel, 4,350 feet in length, with 90,000 cubic yards of excavation, is let to P. Keating, of Ohio. Mr. Keating is not yet on the ground. This tunnel is nine miles from Shippensburg, the nearest shipping point. No. 2, or Kittattinning mountain, is let to Ackerman & Evans, of Binghampton, N. Y., who are on the ground. This tunnel will be 4,635 feet long with 95,200 cubic yards excavation. The west portal of No. 1 and the east portal of No. 2 are but 500 feet distant. These two are called the twin tunnels. No. 3, or Tuscarora mountain, is let to Walker Dacey & Co., of New Jersey. They were not on the ground last week. This tunnel will be 5,400 feet long, with 112,120 cubic yards excavation. No. 4, or Sidling hill, is let to Rodgers & O'Brien, of Poughkeepsie, N. Y., who are now at work. This tunnel will be the longest on the line, being 6,700 feet long, and 143,240 cubic yards excavation. No. 5, or Ray's hill, is let to McMahon, Shanahan & Green, of Virginia, who are also on the ground. This tundel will be 3,620e feet in length and 81,720 cubic yards excavation. No. 6, or Alleghany mountain, is let to Charles McFadden, Philadelphia. Shanties are now being built and operations will soon begin. This tunnel will be 5,900 feet long and 128,700 cubic yards excavation. No. 7, or Laurel hill, let to Mr. Rock, who it is said has thrown it up, will be 5,400 feet long and 110,160 cubic yards excavation.

A GREENFIELD well, recently completed, is 150 feet deep, and now has 110 feet of water in it.

The Sewerage of Nahant.

An unusual prevalence of typhoid fever in Nahant in 1881 awakened its people to the necessity of investigating the causes of the trouble, and, if possible, of providing a remedy therefor. Mr. Bowditch has already given in a paper entitled the "Sanitary Aspects of Nahant," some statements as to the condition of the town at that time.

Believing that an examination of the drinking water might contribute to the desired object, an analysis of the water of one hundred and ninety wells and cisterns used for drinking purposes was made. Of this number, seventy-nine were classed as good or desirable in variable degrees, and one hundred and eleven were considered to be suspicious or bad.

In summing up the cases of typhoid, he says: "Some of these cases were 'imported' from other towns; others occurred where the drinking water is quite undesirable or bad; still others, where the surroundings seem particularly favorable for the propagation of zymotic diseases. In fact, there is but one case out of nearly eighty that cannot be accounted for by filthy surroundings, bad drinking water, or importation."

With these facts in view, the following remedies were proposed.—

First. To advise a system of sewer pipes sufficient for the present use and future growth of the town.

Second. So far as possible to cleanse the wells and cisterns, and put them in better condition than they were in the summer of 1881.

Third. To obtain a purer supply of ice.

Fourth. To be certain that the cans of milkmen are rinsed with pure water.

Fifth. To deliver drinking water of known purity to every householder who expresses a willingness to use it to the exclusion of other supplies, and at least [at those houses where typhoid existed last year, to insist on its use as far as possible.

The two first propositions have been carried out. The sewers have been constructed, and with what results the paper of Mr. Bowditch will show. The plan adopted is the separate plan, excluding all storm water, this being thought to be best adapted to a town and community like that of Nahant. This beautiful resort is not only provided with a most thorough and perfect system of sewerage, but also presents a commendable example of what may be termed a correct sanitary sequence, such as is not often adopted, viz: that of constructing the proper channels for its effluent water before introducing the water.

Another question presented in this paper is one of much interest to sanitarians, the "Recovery of soils from pollution." Thus far this important topic has been neglected in America; but we trust this paper will awaken an interest in it which shall result in a thorough investigation of the subject.

Building Prospects in Minneapolis.

One of the oldest contractors and builders in the city said to the writer last evening: "One of the safest predictions you could make is that more blocks and buildings will be erected along our business streets next summer than in any two previous seasons in the history of our city. Why, architects are overworked, and in some cases it has been found necessary to send elsewhere for plans. An immense quantity of building material has been ordered for delivery early next spring; contractors are piling up orders in advance, and six months hence will see busy times on our business streets. I think that you may also safely predict that among other structures upon which work will be begun early will be several suitable for the jobbing trade. I personally know of two parties who are desirous of locating here in the jobbing trade, if they can secure proper buildings in the right locality."—*Minnesota Tribune.*

PUBLIC WORKS.

The following is a list of bills, petitions, etc., relating to public works which have already been introduced in Congress:

For marine hospital at city of New York.

For bridge over the Rio Grande, between the city of Eagle Pass, Tex., and Piedras Negras, Mexico.

For public building at Waco, Texas.

For public building at San Antonio, Texas.

For public building at Carson City, Nevada.

For public building at Lacrosse, Wisconsin.

A continuance of work on the bars at the mouth of the St. John's river, Florida.

For continuance of work on the jetties at Charleston (S. C.) Harbor.

For public building at Greenville, S, C.

For purchase of site for public building, San Francisco, Cal.

For public building at Camden, N. J.

For public building at Lexington, Ky.

For bridge over the Mississippi river at St. Louis, Mo.

For purchase of ground and the erection thereon in the city of Washington of a building to be used as a hall of records.

For construction of bridges across the Missouri, between its mouth and the mouth of the Dakota or James river, and across the Mississippi river between St. Paul, Minn., and Natchez, Miss., and across the Illinois river between its mouth and Peoria.

For public building at Jacksonville, Fla.

For public building at Key West, Fla.

NEWS OF THE WEEK.

Proposed New Buildings in New York.

On the southeast corner of the Grand Boulevard and Sixty-second street, a first-class fireproof, twelve-story apartment house is about to be erected. The plot of land selected is 116.2x83.3x100.5x146.8.

On the plot of land situate on the north side of Seventy-sixth street, west of Ninth avenue, seven first-ciass four-story brown-stone dwellings are about to be erected by Mr. Hugh Blesson, to cost $100,000.

Four five-story brick tenement houses are in course of erection on the south side of One Hundred and Twentieth street, ninety feet west of Lexington avenue, by Patrick Dempsey, to cost $72,000.

A five-story brick flats, 25x27, is about to be erected on the lot, No. 327 West Forty-second street, by Samuel McMillan, to cost $25,000.

Two five-story brick tenement houses are in course of erection on the south side of Fifty-seventh street, 210 feet east of Third avenue, by Kunkel & Stauffer, to cost $36,000.

Four five story brick flats are about to be built on the north side of Sixty-seventh street, 125 feet east of Fourth avenue, by Wall & Weyer, to cost $125,000.

Three five-story brick tenement houses are in course of erection on the north side of Seventy-seventh street, 94 feet east of First avenue, for the same owner at a cost of $49,500.

A five-story brick tenement house is about to be built on the lot No. 224 East Eighty-first street, by Peter Seebold, to cost $17,500.

Bridges.

THE Baltimore & Ohio Railway Company, is about to begin the construction of a great bridge at Havre de Grace, Md., at the head of the Chesapeake Bay. The bridge is to rest on granite piers which will be founded on the bedrock by means of pneumatic caissons sunk after the manner of those at the East river and St. Louis bridges. There are to be five of these caissons, each about 40x80 feet in area, and they are to be sunk to depths varying from 50 to 85 feet below water surface. The grade line will be 90 feet above water, there being no draw. Where crossed by the Baltimore & Ohio the river is over a mile wide, and is divided into two channels by an island. Thus there will, in reality, be two bridges. The longest span is to be 520 feet, and most of the remaining ones 400 feet each.

A NEW highway bridge, to cost $60,000 is to be built across the Connecticut River at Windsor Locks. It is to be of iron, 1200 feet long; 14 feet wide; 6 spans; Charles L. Burdett of Hartford, William H. Law of New Haven, and Newton S. Pomeroy of Suffield are appointed a committee to determine when the bridge is completed according to law. The officers of the company are: President and treasurer, James R. Goldson; Secretary, F. H. Whittlesey, Warehouse Point. The company last spring secured a special act of incorporation in the Legislature for its purpose. Several meetings have been held, an organization effected and plans drawn up, and the company are about ready for proposals to do the work.

THE new iron bridge over the Wateree river near Camden has at last been completed.

COMMISSIONERS John E. Pond. Hans Neilson, and T. T. Flagler have handed down a decision in the long-contested Wilmer case—claims against the new Canada Southern Bridge Company in the matter of taking land belonging to said estate at Suspension Bridge for the approaches to the new canti-lever bridge. The Commissioners awarded the estate $3,500 for the land actually taken for the approaches. The highest that the railroad company had offered was $2,500. The settlement is believed to be satisfactory. The interesting question of increased value of property caused by the bridge works constructed by the tresspassers was by mutual consent settled between the parties before the award was made.

THE activity in ship-building on the Clyde and the Tyne is rapidly collapsing. The prices of materials and of ships are declining, and a number of the ship-building firms have no new orders. The workingmen upon the Clyde have held a meeting and offered to accept a reduction of 5 per cent. in their wages. They hope by this move to induce the builders to keep their yards open. It is only a question of a short time when 10,000 artisans in the Clyde Valley will be thrown out of employment.

Water, Gas and Steam.

CONCORD'S $50,000 addition to its water-works was completed last week. This provides a new 2,000,000 gallon reservoir, and will give the N. H. State-prison 100,000 gallons a day.

THE contract for building the Dennison, Texas, water-works has been close with Drake & Orton, of Rock Island, Ill. It calls for sixty fire plugs at an annual rental of $6000. The works will be on the Holly plan and machinery and hydrants will be furnished by the Holly Manufacturing Company, of Lockport, N. Y. About eight miles of pipes will be laid and the works completed by July, 1884.

NEWTON, KAS., has given water-works franchise to James Hill and associates; works will be completed in six months. Iron tank reservoir. T. S. Moorhead of Milton, Pa. is the engineer.

THE water-works at Lewisburg, Pa., are completed at a cost of $35,000. About five miles of mains, two compound duplex Knowles pumps, stand pipe 12 feet diameter and 130 feet high. Water is taken from west branch of the Susquehanna river.

PLAINVILLE, CONN., has organized a stock company to supply the village with water.

GEO. B. INMAN, a well-known contractor is "prospecting" Paola, Kansas for a contract to build water-works.

THE Waterbury (Ct.) pump is forcing 600,000 gallons of water daily into the city mains from the river and the danger of a water famine is past. The city will probably have to depend upon the pump all winter.

STAFFORD SPRINGS, CONN., is very earnestly discussing the subject of water-works. A proposition to build works has been submitted by a private company.

AT THE test of the new Rich Hill, Mo., water-works, Nov. 28, four fire streams were thrown 116 feet high and maintained for one hour.

WE ARE always very much obliged for items of news relating to construction of water and gas-works. Our sources of information are largely the daily newspapers, but these contain the news of but a small proportion of what works are projected or built. We can hardly place a money value on such items as they may come from several different correspondents, but to all who exhibit an interest in sending early notices of new water-works, we will reciprocate in liberal discounts on books or materials bought through us.

THE town of Lake View, the adjoining northern suburb of Chicago, Ills., will furnish the village of Jefferson with water for a term of not more than five years and not less than three years, upon the payment by the village of Jefferson of its proportional part of the current expense of running said water-works, the proportion to be based upon the actual use of water as shown by the water-books of the two towns, calculated upon the basis of the Lake View water rates at the time of signing the contract, and the further payment of the following sums: For the first year, $5,000; second year, $6,000; third year, $7,000; fourth year, $8,000 and fifth year, $9,000—all payments to be made semi-annually. Mr. John A. Cole, engineer of both towns, estimates the cost of mains from the Lake View Works to Jefferson, a distance of three miles as follows: A twenty-four inch pipe would cost in the neighborhood of $65,000, while a 20-inch pipe would cost considerably less, but in view of the fact that the town of Jefferson proposes to build water-works of its own as soon as practicable, the larger pipes could be used for their mains, and it was advisable to have the 24-inch pipes. The Jefferson board would lay the pipes to the works at Lake View, and replace all streets and roads as they found them. The pipes for Jefferson would be laid lower than those of the Lake View works.

THE "Waste of Water" problem grows in interest to Water Departments, as they find themselves quite unable to build extensions and new machinery fast enough to keep pace with the wasteful proclivities of the average native American and the quickly tutored foreigners, and instead of exploring the continent for new "water-sheds," they are availing themselves of the inventive genius of the native and are rapidly intrenching themselves behind the strong barriers of the irrefutable water-meters. If a man or a corporation will waste this absolutely necessary but decidedly expensive fluid, let the waste be assessed on the proper parties. The increasing sales of meters by the makers of tha best patterns, prove the growing popularity of this method of increasing a public water-supply. The National Meter Co., at 51 Chambers street, N. Y., advertise their increasing sales and on a personal visit to their factory, we found them enlarging their facilities for manufacturing their popular "Crown" meter. Philadelphia has recently wheeled into line with an order for a dozen each of 1, 2, 3 and 4-inch Crown meters and 2 6-inch with a fair hope for still further orders.

THE drill for the artesian well at the shops of the Winchester Arms Company, at New Haven, Conn., has stuck fast at the depth of 2,000 feet.

Streets, Sewerage and Drainage.

DOLESE & SHEPARD, prominent street contractors, of Chicago, have removed their stone crushing machinery from Stoney Island, in the village of Hyde Park, to Hawthorne, in the town of Cicero, just outside the western limit of Chicago. The firm employ about 100 hands and pay out $50,000 a year in wages and teaming.

THE National Board of Health has forwarded its annaal report for the fiscal year 1882-1883 to Secretary of the Treasury for transmission to Congress. It gives a detailed account of the operations of the board down to the time of its lapse by limitation on the 2d of June last. The total expenditures were $97,333. The board recommends that Congress make adequate provision for its co-operation with local health authorities in the execution and enforcement of their rules and regulations relating to the introduction and spread of contagious diseases in the United States. An appropriaton of $37,700 is asked for the expenses of the board for the next fiscal year.

SOME Kansas City officials have been visiting Memphis in search of ideas. City Engineer Knight said he "found Memphis an active, energetic city, and the excursion was a pleasant one in every respect. The somewhat noted sewer system of Memphis he had become quite familiar with on a previous visit. Their sys-

tem answers a very excellent purpose, but it had been found necessary to almost entirely reconstruct the system as originally furnished by Mr. Waring. The streets of Memphis are very generally paved, but the blocks put down are rough and uneven, making the pavement exceedingly noisy. The blocks had been laid on sand, and were beginning to wear in holes and spots. In public improvements generally the people did not appear to be building as well as they know, the expenditures on public works having been 100 per cent. less than in Kansas City during the past year. With a more favorable location, and being more compact, it was easier to improve Memphis than Kansas City."

THE petitions for paving Union avenue from the bridge to Hickory street, with stone blocks, have been found to contain the signatures of a large majority of the property owners along the street, and proposals to do the work are now being invited by the public improvements committee, The contract for the work is to be let December 20, that date being fixed upon in order that contractors may have an opportunity to put in their bids. It is not anticipated that work on the street will be commenced this year.

LONDON *Times*, Nov. 9:—For some time past a series of experiments on the London sewage have been carried on at the northern outfall of the Metropolitan Board of Works, under the immediate supervision of one of the board's officers, for the purpose of testing a patented process of Messrs. Parker & Andrews, for the deodorization and purification of sewage. The system employed is a very simple one. The sewage is first received into a tank, and is there mixed with the chemicals required for treatment. It is then run into other tanks, when the suspended impurities are precipitated to the bottom of the tanks, and the effluent of pure water is run off into the river. The process claims superiority over all other systems hitherto introduced; it immediately deodorizes and allays decomposition, precipitates all solid matters without adding any appreciable bulk to the deposits, and provides an effluent perfectly clear and tasteless, in which fish can live. The system has been previously tested at the Walthamstow sewage-works, and the result of the analysis of the effluent was that "the solid was not higher than is sometimes found in potable waters, and more than satisfying the requirements of the Rivers Pollution Prevention act." The residuum is treated in the form of sludge, and, after undergoing a simple baking process, has been found to be of high manurial value for agricultural purposes.

THE street improvements of Chicago this year have been as numerous and as satisfactory as in any preceding year. The most expensive piece of work was the granite block pavement on State street, between Jackson and the river, which cost over $70,000. About thirty miles of pavement have been laid this year, all of it wooden blocks, with the exception of the business portion of the city, which is granite.

Railroads.

FLORIDA RAILWAYS.—The rails have been laid to Lady Lake, in Sumpter county, on the Florida Southern R. R.

THE tracklaying of the Jacksonville, Tampa & Key West R. R. is still progressing rapidly, and the expectations are that Black Creek will be crossed this week.

THE greater part of the right-of-way for the Jacksonville & Atlantic R. R. has been purchased or negotiated for.

A PILE wharf is being built at the St. Johns & Lake Eustis railroad depot at Tavares.

Two locomotives and five passenger coaches have arrived at Sanford for the South Florida Railroad. Two other locomotives have been ordered.

A LARGE portion of the right-of-way of the Connecticut Air Line Railway has been obtained. It is understood that none of the stock or bonds of the road will be issued until the road is completed, fully equipped and running. The New York office of the company is at No. 24 Pine street. The officers are S. E. Olmstead, of Norwalk, President; C. V. Sidell, of New York, Treasurer, and Thomas N. Browne, of Brooklyn, Secretary.

A. W. GODSON has ben awarded the contract for subway under the railroad crossing at Queen street, West Toronto, Canada, and he has commenced work. The contract is about $35,000; the prices are: earthwork, 24 cents per yard; brickwork, $5.75; rubber, $7.00 cut stone, $14.00.

HAVING demonstrated the feasibility of adopting a single time standard for the hundreds of lines in this country, the leading railroads are now trying to agree upon a uniform system of signals for train running.

THE New York Central R. R. Co. has notified the Fitchburg R. R. Co. that its through traffic would be withdrawn from the tunnel line after March 1, and that the Wagner coachss would be taken from the line on January 1. The cause of this proposed break is said to be the connection of the Fitchburg road with the Erie, and thus with the West Shore road.

D. F. HOLMAN, of the firm of McLennan & Holman, 94 Dearborn street, Chicago, has, after years of patient labor and experiment, perfected a steam Railway Tracklayer, for which he has applied for a patent. Mr. Holman has also added numerous improvements to the machinery for tracklaying which they have been making for some years past, by which many annoyances and much expense in laying railroad track are avoided. Mr. Holman has just returned from Florida, where he went to start a tracklaying machine for the Jacksonville, Tampa & Key West R. R. Co.

Officers were elected on the 27th ult. in the new railroad company incorporated recently to build a railroad from Attica to Lockport and Youngstown, N. Y. Col. R. S. Stevens is President. New York parties back the enterprise. The surveyors are at work.

THE Boston *Herald* recently sent Mr. D. L. Robbins, of its staff, to Minneapolis to investigate the prospects for construction of the proposed Minneapolis & Sault Ste Marie R. R. The Minneapolis *Tribune* says that "Mr. Robbins, after consultation with the gentlemen at the head of the enterprise, returns to Boston fully impressed by the fact that the Sault Ste Marie railroad is not only an assured fact, but that it will be constructed with all the speed that energy and money can command."

THE rumored possible lease of the West Shore & Buffalo R. R. to the Penn'a R. R., has been admitted by the officials of the first named road as being among the possibilities; but the Penn'a officicals say that they have a satisfactory traffic contract with this road, and have no intention by purchase or lease of entering further into competition for New York traffic.

ARTICLES of incorporation of the Burlington, Lafayette & Western Railroad were filed at Indinapolis, Ind., on Dec. 4. The terminal points are to be Kokomo and Veedersburg, Ind. The road is to be 75 miles long, running through Lafayette and Burlington, Ind.

THE Fort Wayne, Peoria & Galesburg Railroad has filed articles of incorporation, to construct a road between the cities named.

A NEW route has been selected for the Quincy, Vandalia & Eastern Railway, north-west from Shipman, Ill., one and one-half miles north of Kane, one mile north.west of Carrolliton, crossing the Apple Creek at Seeley's Mills then follows the Illinois River Bottom under the bluff, crossing the C. & A. near Happyville, Ill., after which it crosses the Illinois River at Bedford. The survey will be continued to a connection with a line surveyed last spring near Pittsfield. Engineers will go to work in a short time. The company proposes to build the road from Dorchester, on the I. & St. L. road, over this line, selected to Quincy. It is said that the C., C. & I. road (Bee Line) is backing the enterprise. It is proposed to get the preliminary matters all arranged so as to commence the construction early in the spring.

THE Johnsonburg & Clermont company has filed articles of incorporation to build a railroad from Clermont, in McKean county, Pa., to Johnsonburg, on the Philadelphia & Erie road, a distance of twenty miles. It will be an extension of the Buffalo, New York & Philadelphia's Clermont branch.

THE Cherry Grove & Hickory Valley company has been organized to build a narrow-gauge road from Garfield, in Warren county, Pa., to West Hickory, in Forest county, a distance of twenty miles.

IRON, METAL AND COAL MARKETS.

PHILADELPHIA, Dec. 6, 1883.

Transactions in Iron and Steel for the past week have been of small proportions, owing to the general depression in iron circles, and the dullness incident to the near approach of the holiday season. The only activity worthy of the name, has been in the standard and special brands of Forge and Foundry Irons, for which there have been quite an active demand. Some consumers, anticipating an upward tendency in January, have been making offers for large stocks, and some good sales have been made at $20.50@22 for No. 1 Foundry, $19@$20 for No. 2, and special grades of Forge Iron at $19. The better makes are well sold up but the poorer are in dull demand and stocks are large. Finished Iron is in a very discouraging condition. The new cards, at 2.10, were sent out on last Saturday, and small store lots are selling at that price, but good iron has sold at 1.80, and most of the business doing is from that price up to 2c. A number of mills will close down on the 15th, and some manufacturers state that they will not start up again until there is a decided improvement in demand. The demand for Nails is irregular and prices are weak. Quotations, $2.75@$2.90. Some large lots of Steel Rails have been sold in Western Mills, and there are negotiations now pending for large blocks, for which it is thought less than $35 will be accepted. Offers are made at $33@35. It is rumored that if a further reduction is made, some more mills will shut down. There are large requirements for iron for engineering work, but no large orders have been placed recently and it is not probable that much business in this direction will be done before the first of the year. Mills are about out of large orders, but have enough small orders to keep them working along, filling current requirements. Prices are firm for large lots, but concessions would be granted to secure heavy business. Quotations are, 2.40@2.50 for Angles; 2.75@3c. for Tees, and 3.50 for Beams and Channels. Muck Bars are selling slowly at $33. Old Rails, $23.25 for Tees, Double-Heads are offered at $25.

COAL.

The past week has been the dullest one known in the Anthracite Coal trade for several months. Southern and Eastern trade have fallen off largely, owing to the fact that most of the large requirements of those sections have been filled, and also to the fact that the decision of the companies to restrict output, has led to the impression that stocks are large, and also to the hope, in some quarter, that there will be a weakening of prices. The Western demand keeps up well, and inquiries are arriving freely, showing that large stocks will be wanted there for some time to come. There is a rather limited supply of vessels at Port Richmond, and in consequence of this fact, and the falling off of demand, stocks at that point are accumulating. Production reported for the week ending Dec. 1st, 698,451 tons, and for year, to same date, 29,148,988 tons, as against 26,870,065 tons for the same time last year. The Pennsylvania Railroad Company carried, so far this year, 8,227,441 tons coal, and 2,823,484 tons coke.

The Bituminous trade is still dull and there is no hope of any improvement in the near future. The production is enormous but prices are very low and seem to be growing weaker and weaker. From all indications, competition will be even more active next year than this, and the only thing that can improve the trade is a sharp restriction; but it is not probable that this policy will be followed. The production of the Cumberland region for last week was, 50,330 tons gross; Clearfield region, 57,769 tons, and Broad Top, 4,722 tons. The production of the entire region, up to last Saturday was, 5,142,086 tons.

PITTSBURGH, Dec. 6, 1883.

The western Pennsylvania Iron trade has not improved within the past week, and most of the business done has been in small lots for current requirements, at prices affording very narrow margins of profit. Some bar mills report a fair activity and steady prices, while others are almost without work, and makers as a general thing, are very much discouraged at the outlook. Nominal quotations for Bars are 1.80@2c., but lower prices have been accepted. Bessemer Iron has been in active demand, and 100 to 1,000 ton lots have sold at $20.50 @$21. Forge Iron has sold at $17.50@$18.50; Mottled, $10.50@$10.75; Muck Bars, $32.50@$33.50, with offers at $31 @$32. There is an active demand for old material, but few sales are reported, owing to the high prices asked. Nails are very dull and jobbing lots are going at $2.50@ $2.65, a few car load lots having been sold, it is said, as low as $2.40@$2.45. Foundry Iron is in dull request at $18@$20 for No. 2, and $20@$21 for No. 1. Small Railway Material is in active demand. Steel Rails are wanted in large lots and offers range from $33@$35, according to size of order, and date of delivery. The coal trade is dull and steady. The Glass trade is active with no prospect of an early settlement of the strike.

CHICAGO, Dec. 6, 1883.

Transactions in Bar Iron for the past six days have shown a little more activity, but the trade is still of small proportions. Prices are tolerably steady at $2 for best quality. Structural Iron is in very dull demand, owing to the closing of the building season, and prices are weak, and large concessions can be easily had. Nominal quotations are unchanged, at 2.70 for Tank; 2.80@ 2.85 for Angles; 3.60 for Beams, and 3.80 for Channels, Flange, 4.75; Shell, 3.75; Galvanized Iron is quiet and is quoted at 45 and 5 off for Juniata, and 45 and 10 off for Refined. Prices for Tin Plates are nominally unchanged but are being cut very low. Demand is unusually light. Nails are in good demand at $2.70@$2.75. The finer grades of Steel are active and firm, but the reverse is true of low grades, and purchases are for immediate requirements only. There are rumors of large orders for Steel Rails having been booked, but no definite information can be obtained. There have been some sales at western mills at $37. Prices for Pig Iron are steady, and demand moderate. Forge Irons are in declining demand. Southern Irons are gaining steadily in favor. The Hardware trade is active, and prices firm.